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(54)【発明の名称】　有機エレクトロルミネッセンス素子

(57)【要約】

【目的】　構成が簡単で、特に青色純度を高めた有機エレクトロルミネッセンス素子（有機ＥＬ素子）を提供すること。

【構成】　（１）基板／高屈折性透明電極／有機多層部／陰極の構成において、該透明電極と有機多層部との合計光学膜厚が、（２）基板／高屈折性下地層／透明電極／有機多層部／陰極の構成において、該下地層と透明電極と有機多層部との合計光学膜厚、又は透明電極と有機多層部との合計光学膜厚が、（３）基板／低屈折性下地層／透明電極／有機多層部／陰極の構成において、透明電極と有機多層部との合計光学膜厚が、屈折率1.６～1.８の有機多層部より発生するＥＬ光の中心波長λ（λは４４０～４９０ｎｍ，５００～５５０ｎｍ及び６００～６５０ｎｍより選択される。）における強度を増強するように設定されている有機ＥＬ素子である。

し、さらに詳しくは、特定の構成の素子において、陽極から陰極までの光学膜厚を制御し、特に青色発光の色純度を高めた有機ＥＬ素子に関するものである。

【０００２】

【従来の技術】一般に、ＥＬ素子は自己発光性であるため視認性が高く、かつ完全固体素子であるため、耐衝撃性に優れるとともに、取扱いが容易であることから、各種表示装置における発光素子としての利用が注目されている。ＥＬ素子には、発光材料に無機化合物を用いた無機ＥＬ素子と有機化合物を用いた有機ＥＬ素子とがあり、このうち、有機ＥＬ素子は、印加電圧を大幅に低くしうるために、その実用化研究が積極的になされている。上記有機ＥＬ素子の構成については、陽極／発光層／陰極の構成を基本とし、これに正孔注入輸送層や電子注入輸送層を適宜設けたもの、例えば陽極／正孔注入輸送層／発光層／陰極や、陽極／正孔注入輸送層／発光層／電子注入輸送層／陰極などの構成のものが知られている。該正孔注入輸送層は、陽極より注入された正孔を発光層に伝達する機能を有し、また、電子注入輸送層は陰極より注入された電子を発光層に伝達する機能を有している。そして、該正孔注入輸送層を発光層と陽極との間に介在させることによって、より低い電界で多くの正孔が発光層に注入され、さらに、発光層に陰極又は電子注入輸送層より注入された電子は、正孔注入輸送層が電子を輸送しないので、正孔注入輸送層と発光層との界面に蓄積され発光効率が上がることが知られている。

【０００３】このような有機ＥＬ素子においては、陽極と陰極との間に介在する有機多層部における各層の膜厚、例えば正孔注入輸送層，発光層，電子注入層の各膜厚を制御し、最大の効率及び最高の輝度を得る試みが多くなされている。例えば、陽極／正孔輸送性発光層／電子輸送層／陰極の構成において、電子輸送層の膜厚を３０～６０ｎｍに制御して、発光効率の向上を図った技術が開示されている（特開平４－１３７４８５号公報）。これは、発光層と陰極間の距離が重要な因子であることを示している。また、電子輸送層の膜厚を制御し、発光層から生じる光と陰極から反射してくる光とが干渉する際に、実質的に増強されるようにした技術が開示されている（特開平４－３２８２９５号公報）。

【０００４】しかしながら、これらの技術においては、２つの反射性界面で挟まれている有機多層部を含む層の光学膜厚を選定することにより、素子の色純度が改善できることは、何ら示されていない。さらに、これらの技術では、電子輸送層の膜厚を制御することが必要であるが、この場合、電子注入層が発光に関与し、色純度が劣化したり、効率が低下するなどの好ましくない事態を招来し、その改善が求められていた。また、陽極と陰極との間に、金属酸化物を挿入した構成のＥＬ素子が開示されている（特開平４－３３４８９５号公報）。しかしながら、この技術においては、有機層の劣化をもたらす紫外線を遮断する目的で金属酸化物層が設けられており、本発明の技術を示唆するものではない。さらに、陽極／正孔注入層／発光層／電子注入層／陰極の構成であって、該電子注入層として、特定の金属錯体とこれ以外の有機化合物との混合層を用いたＥＬ素子が提案されている（特願平５－９６４０７号）。しかしながら、この技術においては、有機多層部の光学膜厚を、発生するＥＬ光の選定された波長における強度を増強するように設定していないし、またなんらこれについて示されていない。また、基板／誘電体多層膜／透明電極／有機多層部／陰極からなる素子において、透明電極と有機多層部との合計光学膜厚を制御することにより、色純度を向上させる技術が知られている。しかしながら、この技術においては、誘電体多層膜を用いる必要があり、コスト高になるのを免れない。

【０００５】他方、透明電極／誘電体層／蛍光体層／誘電体層／背面電極の構成において、蛍光体層又は蛍光体層と誘電体層との積層構造体の膜厚（ｄ）と、その屈折率（η）とが、ｄ＝ｋ・η・λ／２（ここで、λは発光波長である。）の関係式を満たすようにした技術が開示されている（特開平２－４６６９５号公報）。この技術においては、該蛍光体層にＺｎＳなどの無機蛍光体が、また誘電体層には酸化物などからなる絶縁膜が用いられており、そして、蛍光体層又は蛍光体層と誘電体層との積層構造体の膜厚を、その屈折率に応じて設定することにより、透明電極と誘電体層との界面と、誘電体層と背面電極との界面の間を、蛍光体層から発せられる光を多重反射後、干渉するようにしている。しかしながら、この構成では、誘電体層や蛍光体層の屈折率は2.０以上である一方、透明電極の屈折率が1.８程度以下であるため、該透明電極と誘電体層との界面を反射性として取扱っている。これに対し、本発明で開示している透明電極／有機多層部／陰極の構成においては、有機多層部の屈折率が1.６～1.８であって、透明電極と有機多層部との界面は反射性であるとはいえない。上記特開平２－４６６９５号公報では、本発明のように、透明電極と基板との界面、又は透明電極と高屈折性下地層との界面、又は透明電極と低屈折性下地層との界面を反射性として取扱い、かつ透明電極と有機多層部との合計光学膜厚を制御することについては、なんら示されていない。

【０００６】

【発明が解決しようとする課題】本発明は、このような事情のもとで、特定の構成の素子において、陽極から陰極までの光学膜厚を制御し、特に青色発光の色純度を高めた有機ＥＬ素子を提供することを目的としてなされたものである。

【０００７】

【課題を解決するための手段】本発明者らは、光学膜厚を制御し、青色発光の色純度を高めた有機ＥＬ素子を開発すべく鋭意研究を重ねた結果、（１）基板／高屈折性

性透明電極と有機多層部との合計光学膜厚を設定した場合、素子より出るＥＬ光は、その中心波長が増強され、色純度が向上するという顕著な効果を奏する。この効果が優れている場合、有機ＥＬ素子の色は鮮明となり、フルカラーのためのＲ，Ｇ，Ｂのいずれを実現する場合にも利用することができる。

【００１１】次に、本発明の有機ＥＬ素子〔２〕及び〔３〕は、基板／高屈折性下地層／透明電極／有機多層部／陰極から構成されている。該基板、有機多層部及び陰極としては、前記有機ＥＬ素子〔１〕で説明したものと同じものを用いることができる。また、高屈折性下地層は、屈折率1.８以上の高い屈折率を有する実質上透明な層であり、好ましくは屈折率が2.０以上の酸化物層、例えばTiO_2，ZrO_2，ＺｎＯ，ＳｉＯ，Sc_2O_3，HfO_2，CeO_2など、従来知られている光学的に透明な誘電体からなる層である。さらに、ＺｎＳ，ＺｎＳＳｅ，ＺｎＴｅ，ＧａＮ，ＩｎＧａＮ，ＡｌＮ，ＢｅＮなどからなる層も好適である。一方、透明電極としては、前記有機ＥＬ素子〔１〕の高屈折性透明電極の説明において例示した誘電性透明材料を電極物質とするものを用いることができるが、その屈折率は1.８以上であるのが有利である。

【００１２】本発明の有機ＥＬ素子〔２〕においては、基板と高屈折性下地層との界面で光の反射が生じる場合であり、したがって、高屈折性下地層と透明電極と有機多層部との合計光学膜厚を、屈折率1.６～1.８の有機多層部より発生するＥＬ光の中心波長λ（ここで、λは上記と同じである。）における強度が増強されるように設定することが必要である。すなわち、一般に、有機多層部の光学膜厚を$(nd)_1$，透明電極の光学膜厚を$(nd)_3$，高屈折性下地層の光学膜厚を$(nd)_4$とした場合、これらの合計光学膜厚〔$(nd)_1+(nd)_3+(nd)_4$〕が、式

$$4\pi/\lambda\,[(nd)_1+(nd)_3+(nd)_4]=2m\pi \quad \cdots \text{(III)}$$

又は

$$4\pi/\lambda\,[(nd)_1+(nd)_3+(nd)_4]=(2m-1)\pi \quad \cdots \text{(IV)}$$

〔ただし、λ，ｍ，ｎ及びｄは、上記と同じである。〕の関係を満たすように設定される。上記式（III），（IV）は有機ＥＬ素子〔１〕の場合と同様に陰極金属の屈折率により選ばれる。

【００１３】一方、有機ＥＬ素子〔３〕においては、高屈折性下地層と透明電極との界面で光の反射が生じる場合であり、したがって、透明電極と有機多層部との合計光学膜厚を、屈折率1.６～1.８の有機多層部より発生するＥＬ光の中心波長λ（ここで、λは上記と同じである。）における強度が増強されるように設定することが必要である。すなわち、一般に、有機多層部の光学膜厚を$(nd)_1$，透明電極の光学膜厚を$(nd)_3$とした場合、これらの合計光学膜厚〔$(nd)_1+(nd)_3$〕が、式

$$4\pi/\lambda\,[(nd)_1+(nd)_3]=2m\pi \quad \cdots \text{(V)}$$

又は

$$4\pi/\lambda\,[(nd)_1+(nd)_3]=(2m-1)\pi \quad \cdots \text{(VI)}$$

〔ただし、λ，ｍ，ｎ及びｄは、上記と同じである。〕の関係を満たすように設定される。上記式（Ｖ），（VI）は、有機ＥＬ素子〔１〕の場合と同様に陰極金属の屈折率により選ばれる。但し、（有機多層部の屈折率）＜（金属の屈折率）の場合は式（Ｖ）が、またその逆の場合は式(VI)が選ばれる。

【００１４】また、高屈折性下地層と透明電極との界面、及び基板と高屈折性下地層との界面の両界面で反射が生じる場合がある。例えば、透明電極の屈折率＜高屈折性下地層の屈折率＞基板の屈折率であって、それぞれの屈折率差が大きい場合である。このような場合には、光学膜厚を、式

$$4\pi/\lambda_1\,[(nd)_1+(nd)_3]=(2m-1)\pi \quad \cdots \text{(VII)}$$

$$4\pi/\lambda_2\,[(nd)_1+(nd)_3+(nd)_4]=2m\pi \quad \cdots \text{(VIII)}$$

〔ただし、ｍ，ｎ及びｄは、上記と同じである。〕の関係を満たすように設定する。上記式(VII)，(VIII)において、λ_1及びλ_2は、青色の場合は４４０～４９０ｎｍ，緑色の場合は５００～５５０ｎｍ，赤色の場合は６００～６５０ｎｍより選択されるが、必ずしも一致しなくてもよい。また、式（VII），(VIII)は、前記有機ＥＬ素子〔１〕の場合と同様に、（有機多層部の屈折率）＞（陰極の屈折率）の場合であるが、この逆の場合には、式

$$4\pi/\lambda_1\,[(nd)_1+(nd)_3]=2m\pi \quad \cdots \text{(IX)}$$

$$4\pi/\lambda_2\,[(nd)_1+(nd)_3+(nd)_4]=(2m+1)\pi \quad \cdots \text{(X)}$$

の関係を満たすように設定する。このように、上記式（VII)/(VIII）又は式(IX)/（X）を選択するのは、低屈折率側より高屈折率側は入射する場合には光の位相が、π変化するが、その逆の場合には変化量は０であるからである。この位相の変化は、上記の光学膜厚の設定には、当然考慮する必要がある。特に、$\lambda_1=\lambda_2$のとき

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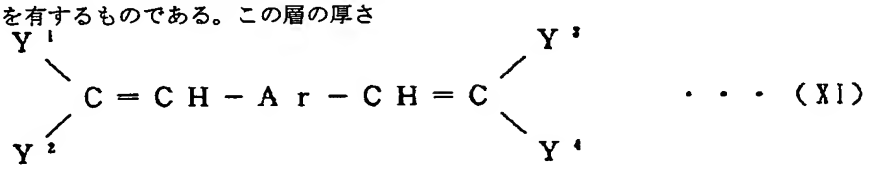
としては、通常の発光層と同様に、（ａ）注入機能（電圧印加時に、陽極又は正孔輸送領域層より正孔を注入可能であり、かつ陰極又は電子注入層より電子を注入可能である。），（ｂ）輸送機能（正孔及び電子を電界の力により移動させることが可能である。），（ｃ）発光機能（正孔と電子の再結合の場を提供し、発光させることが可能である。）を有するものである。この層の厚さは、特に制限はなく、適宜状況に応じて決定することができるが、好ましくは１ｎｍ～１０μｍ、特に好ましくは５ｎｍ～５μｍである。ここで、好ましい発光材料（ホスト材料）としては、一般式（XI）

【００１９】

【化１】



・・・（XI）

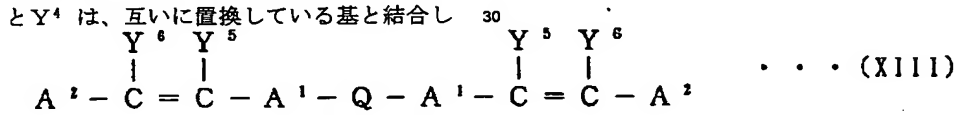
【００２０】〔式中、Y^1～Y^4は、それぞれ水素原子，炭素数１～６のアルキル基，炭素数１～６のアルコキシ基，炭素数７～８のアラルキル基，置換あるいは無置換の炭素数６～１８のアリール基，置換あるいは無置換のシクロヘキシル基，置換あるいは無置換の炭素数６～１８のアリールオキシ基，炭素数１～６のアルコキシ基を示す。ここで、置換基は炭素数１～６のアルキル基，炭素数１～６のアルコキシ基，炭素数７～８のアラルキル基，炭素数６～１８のアリールオキシ基，炭素数１～６のアシル基，炭素数１～６のアシルオキシ基，カルボキシル基，スチリル基，炭素数６～２０のアリールカルボニル基，炭素数６～２０のアリールオキシカルボニル基，炭素数１～６のアルコキシカルボニル基，ビニル基，アニリノカルボニル基，カルバモイル基，フェニル基，ニトロ基，水酸基あるいはハロゲンを示す。これらの置換基は単一でも複数でもよい。また、Y^1～Y^4は、同一でも、また互いに異なっていてもよく、Y^1とY^2及びY^3とY^4は、互いに置換している基と結合して、置換あるいは無置換の飽和五員環又は置換あるいは無置換の飽和六員環を形成してもよい。Ａｒは置換あるいは無置換の炭素数６～２０のアリーレン基を表し、単一置換されていても、複数置換されていてもよく、また結合部位は、オルト，パラ，メタいずれでもよい。但し、Ａｒが無置換フェニレン基の場合、Y^1～Y^4は、それぞれ炭素数１～６のアルコキシ基，炭素数７～８のアラルキル基，置換あるいは無置換のナフチル基，ビフェニル基，シクロヘキシル基，アリールオキシ基より選ばれたものである。〕一般式（XII）

Ａ－Ｑ－Ｂ　　・・・（XII）

〔式中、Ａ及びＢは、それぞれ上記一般式（XI）で表される化合物から１つの水素原子を除いた一価基を示し、同一であっても異なってもよく、Ｑは共役系を切る二価基を示す。〕又は一般式（XIII）

【００２１】

【化２】



・・・（XIII）

【００２２】〔式中、A^1は置換あるいは無置換の炭素数６～２０のアリーレン基又は二価の芳香族複素環式基を示す。結合位置はオルト，メタ，パラのいずれでもよい。A^2は置換あるいは無置換の炭素数６～２０のアリール基又は一価の芳香族複素環式基を示す。Y^5及びY^6は、それぞれ水素原子，置換あるいは無置換の炭素数６～２０のアリール基，シクロヘキシル基，一価の芳香族複素環式基，炭素数１～１０のアルキル基，炭素数７～２０のアラルキル基又は炭素数１～１０のアルコキシ基を示す。なお、Y^5，Y^6は、同一でも異なってもよい。ここで、置換基とは、単一置換の場合、アルキル基，アリールオキシ基，アミノ基又は置換基を有する若しくは有しないフェニル基である。Y^5の各置換基はA^1と結合して、飽和若しくは不飽和の五員環又は六員環を形成してもよく、同様にY^6の各置換基はA^2と結合して、飽和若しくは不飽和の五員環又は六員環を形成してもよい。また、Ｑは、共役を切る二価基を表す。〕で表される化合物が挙げられる。なお、一般式（XII)及び(XIII)におけるＱは共役系を切る二価基を示すが、ここで共役とは、π電子の非極在性によるもので、共役二重結合あるいは不対電子又は孤立電子対によるものも含む。Ｑの具体例としては、

【００２３】

【化３】

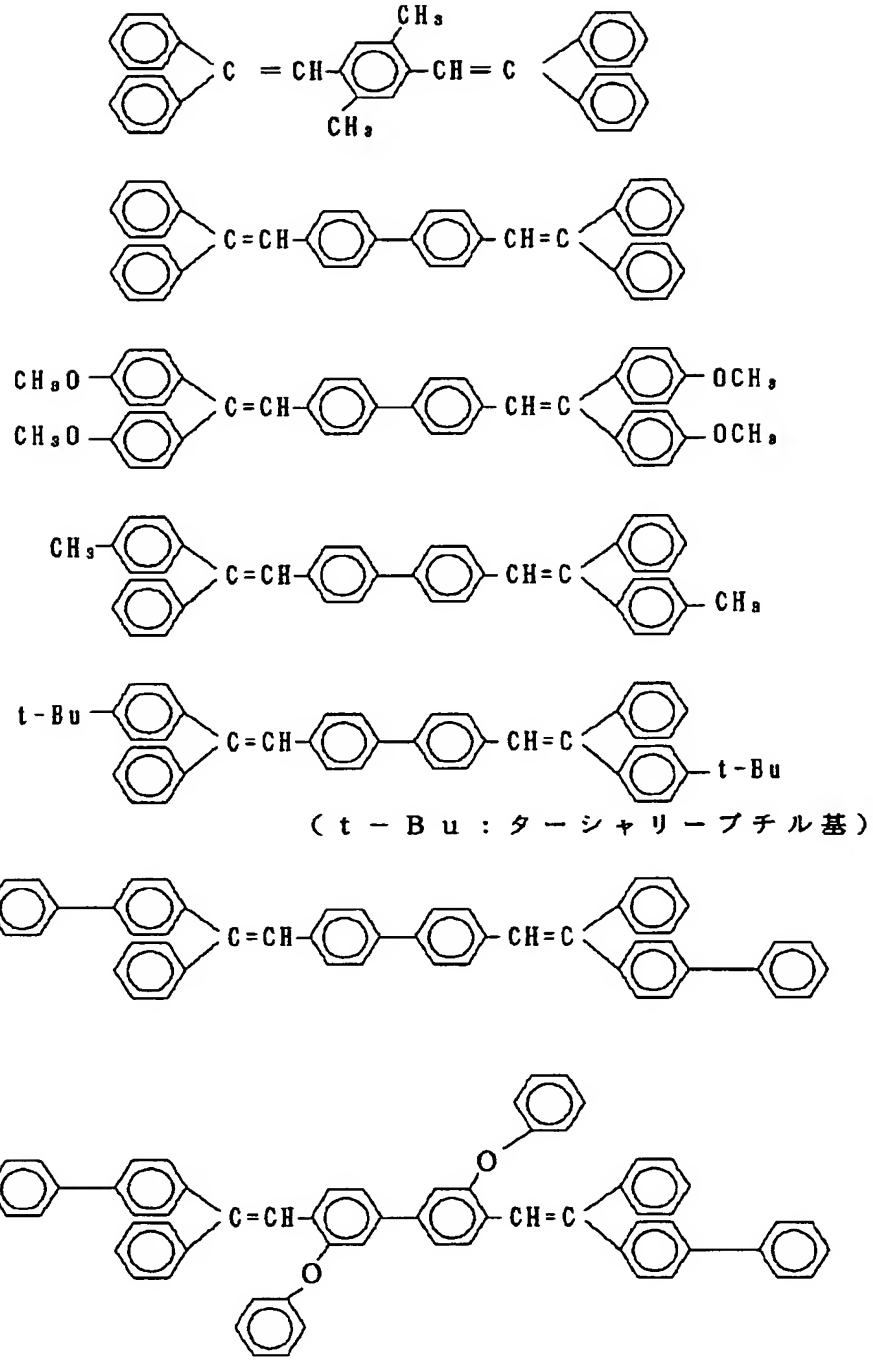
ム又はカルシウムなどのアルカリ土類金属、あるいはホウ素又はアルミニウムなどの土類金属である。一般に有用なキレート化合物であると知られている一価，二価又は三価の金属はいずれも使用することができる。また、Ｚは、少なくとも２以上の縮合芳香族環の一方がアゾール又はアジンからなる複素環を形成させる原子を示す。ここで、もし必要であれば、上記縮合芳香族環に他の異なる環を付加することが可能である。また、機能上の改善がないまま嵩ばった分子を付加することを回避するため、Ｚで示される原子の数は１８以下にすることが好ましい。さらに、具体的にキレート化オキシノイド化合物を例示すると、トリス（８－キノリノール）アルミニウム，ビス（８－キノリノール）マグネシウム，ビス（ベンゾ－８－キノリノール）亜鉛，ビス（２－メチル－８－キノリラート）アルミニウムオキシド，トリス（８－キノリノール）インジウム，トリス（５－メチル－８－キノリノール）アルミニウム，８－キノリノールリチウム，トリス（５－クロロ－８－キノリノール）ガリウム，ビス（５－クロロ－８－キノリノール）カルシウム，５，７－ジクロロ－８－キノリノールアルミニウム，トリス（５，７－ジブロモ－８－ヒドロキシキノリノール）アルミニウムなどがある。

【００２７】上記発光層の形成方法としては、例えば蒸着法，スピンコート法，キャスト法，ＬＢ法などの公知の方法により薄膜化することにより形成することができるが、特に分子堆積膜であることが好ましい。ここで、分子堆積膜とは、該化合物の気相状態から沈着され形成された薄膜や、該化合物の溶融状態又は液相状態から固体化され形成された膜のことである。通常、この分子堆積膜はＬＢ法により形成された薄膜（分子累積膜）と凝集構造，高次構造の相違や、それに起因する機能的な相違により区別することができる。また、上記発光層は樹脂などの結着材と共に溶剤に溶かして溶液としたのち、これをスピンコート法などにより薄膜化して形成することができる。前記一般式（XI）～(XIII)で表される発光層の材料としては以下の化合物が挙げられる。

【００２８】

【化５】

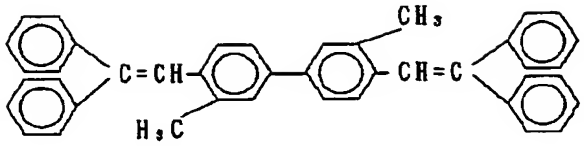
19 20

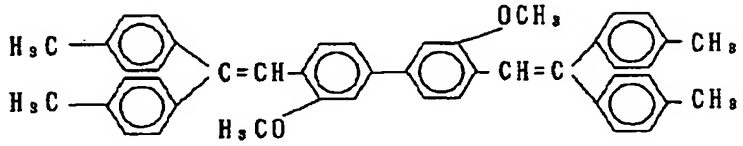


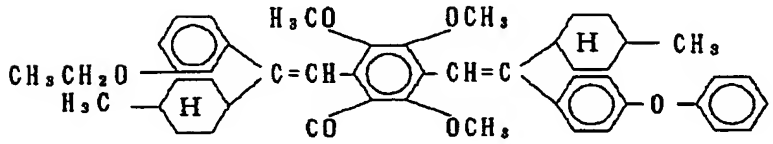
（ｔ－Ｂｕ：ターシャリーブチル基）

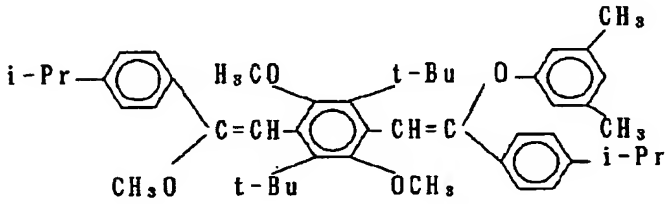
【００３０】 【化７】

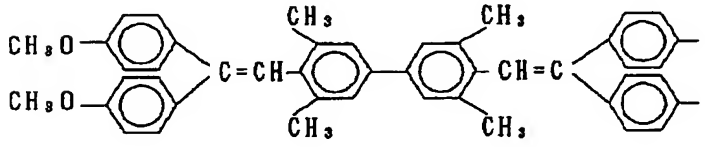
23 24

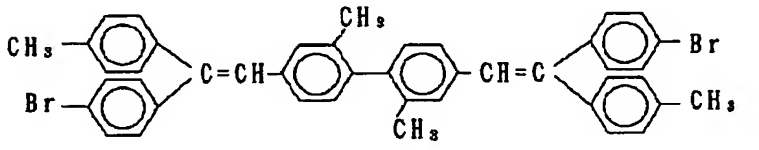


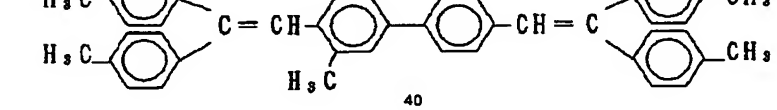












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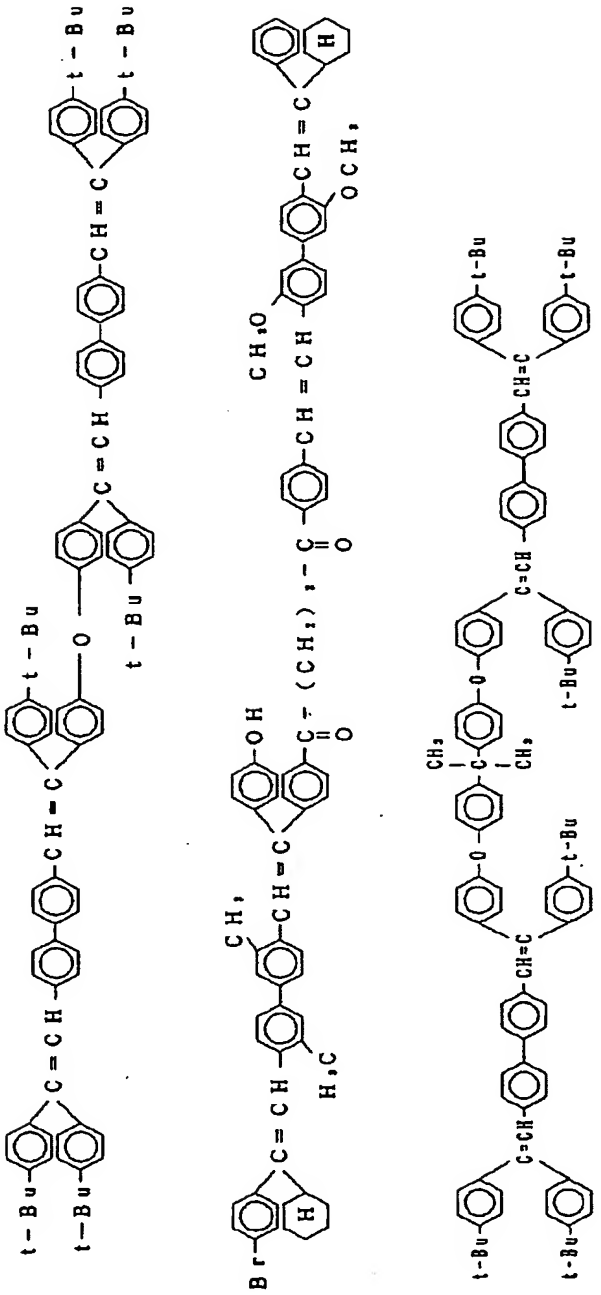
【００３２】

【化９】

27 28



【００３４】

【化１１】

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７４号公報，同６２－１０６５２号公報，同６２－３０２５５号公報，同６０－９３４４５号公報，同６０－９４４６２号公報，同６０－１７４７４９号公報，同６０－１７５０５２号公報等参照）などを挙げることができる。さらに、シラザン誘導体（米国特許第4,950,950 号明細書），ポリシラン系（特開平２－２０４９９６号公報），アニリン系共重合体（特開平２－２８２２６３号公報），導電性高分子オリゴマー（特開平１　２１１３９９号公報），特に含チオフェンオリゴマーなどが挙げられる。

【００３７】本発明においては、これらの化合物を正孔輸送材料として使用することができるが、次に示すポリフィリン化合物（特開昭６３－２９５６９６５号公報などに記載のもの）、芳香族第三級アミン化合物およびスチリルアミン化合物（米国特許第4,127,412 号明細書，特開昭５３－２７０３３号公報，同５４－５８４４５号公報，同５４－１４９６３４号公報，同５４－６４２９９号公報，同５５－７９４５０号公報，同５５－１４４２５０号公報，同５６－１１９１３２号公報，同６１－２９５５５８号公報，同６１－９８３５３号公報，同６３－２９５６９５号公報等参照），特に該芳香族第三級アミン化合物を用いることが好ましい。該ポリフィリン化合物の代表例としては、ポルフィン，１，１０，１５，２０－テトラフェニル－２１Ｈ，２３Ｈ－ポルフィン銅（II）；１，１０，１５，２０－テトラフェニル２１Ｈ，２３Ｈ－ポルフィン亜鉛（II）；５，１０，１５，２０－テトラキス（ペンタフルオロフェニル）－２１Ｈ，２３Ｈ－ポルフィン；シリコンフタロシアニンオキシド；アルミニウムフタロシアニンクロリド；フタロシアニン（無金属）；ジリチウムフタロシアニン；銅テトラメチルフタロシアニン；銅フタロシアニン；クロムフタロシアニン；亜鉛フタロシアニン；鉛フタロシアニン；チタニウムフタロシアニンオキシド；マグネシウムフタロシアニン；銅オクタメチルフタロシアニンなどが挙げられる。

【００３８】また該芳香族第三級アミン化合物及びスチリルアミン化合物の代表例としては、Ｎ，Ｎ，Ｎ’，Ｎ’－テトラフェニル－４，４’－ジアミノフェニル，Ｎ，Ｎ’－ジフェニル－Ｎ，Ｎ’－ジ（３－メチルフェニル）－４，４’－ジアミノビフェニル，２，２－ビス（４－ジ－ｐ－トリルアミノフェニル）プロパン，１，１－ビス（４－ジ－ｐ－トリルアミノフェニル）シクロヘキサン，Ｎ，Ｎ，Ｎ’，Ｎ’－テトラ－ｐ－トリル－４，４’－ジアミノビフェニル，１，１－ビス（４－ジ－ｐ－トリルアミノフェニル）－４－フェニルシクロヘキサン，ビス（４－ジメチルアミノ－２－メチルフェニル）フェニルメタン，ビス（４－ジ－ｐ－トリルアミノフェニル）フェニルメタン，Ｎ，Ｎ’－ジフェニル－Ｎ，Ｎ’－ジ（４－メトキシフェニル）－４，４’－ジアミノビフェニル，Ｎ，Ｎ，Ｎ’，Ｎ’－テトラフェニル－４，４’－ジアミノジフェニルエーテル，４，４’－ビス（ジフェニルアミノ）クオードリフェニル，Ｎ，Ｎ，Ｎ－トリ（Ｐ－トリル）アミン，４－（ジ－ｐ－トリルアミノ）－４’－〔４（ジ－ｐ－トリルアミノ）スチリル〕スチルベン，４－Ｎ，Ｎ－ジフェニルアミノ－（２－ジフェニルビニル）ベンゼン，３－メトキシ－４’－Ｎ，Ｎ－ジフェニルアミノスチルベンゼン，Ｎ－フェニルカルバゾール，芳香族ジメチリディン系化合物などが挙げられる。

【００３９】本発明のＥＬ素子における該正孔輸送領域層は、上記化合物を、例えば真空蒸着法，スピンコート法，ＬＢ法などの公知の薄膜法により製膜して形成することができる。この正孔輸送領域層の膜厚は、特に制限はないが、通常は５ｎｍ～５μｍである。この正孔輸送領域層は、上記正孔輸送材料一種又は二種以上からなる一層で構成されていてもよいし、あるいは、前記正孔輸送領域層とは別種の化合物からなる正孔輸送領域層を積層したものであってもよい。

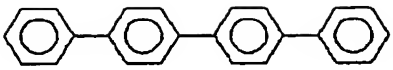
【００４０】さらに、有機半導体層の材料としては、例えば、

【００４１】

【化１２】

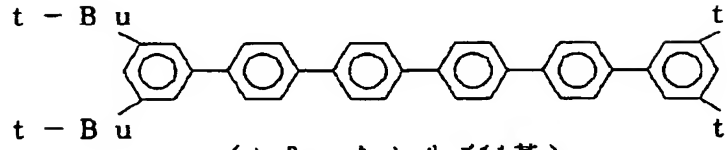
35 36

（１）



（２）

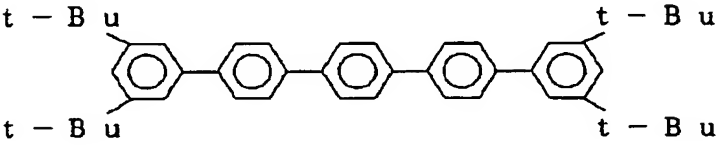
（３）



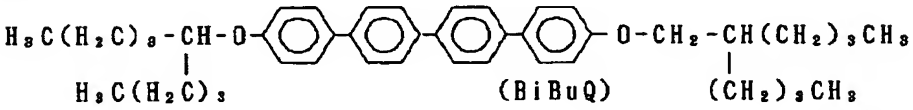
（ＴＢＳ）

（t-Bu：ターシャリーブチル基）

（４）

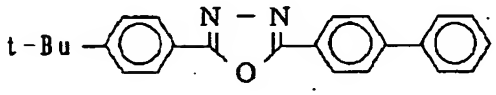


（５）



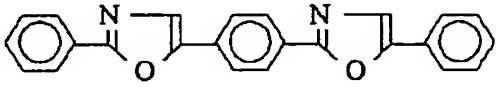
(BiBuQ)

（６）

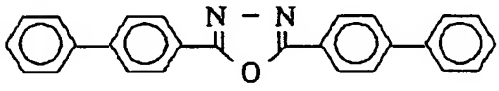


(t-Bu PBD)

（７）



（８）



【００４６】

【化１５】

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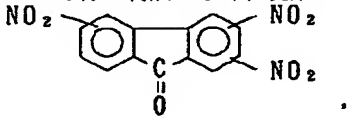
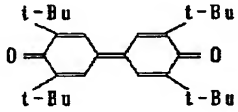
【００４９】また、該有機多層部における電子注入層は、電子注入材料からなるものであって、陰極より注入された電子を発光層にで伝達する機能を有している。このような電子注入材料について特に制限はなく、従来公



【００５１】などのニトロ置換フルオレノン誘導体、特開昭５７－１４９２５９号，同５８－５５４５０号，同６３－１０４０６１号公報等に記載されているアントラキノジメタン誘導体、「ポリマー・プレプリンツ，ジャパン（Polymer Preprints, Japan）」第３７巻，第３号，第６８１ページ（１９８８年）などに記載されている

【００５２】

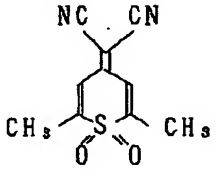
【化１８】



【００５３】などのジフェニルキノン誘導体

【００５４】

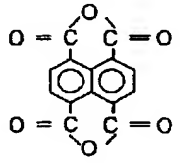
【化１９】



【００５５】などのチオピランジオキシド誘導体

【００５６】

【化２０】



【００５７】などのナフタレンペリレンなど、複素環テトラカルボン酸無水物、あるいはカルボジイミドが挙げられる。さらに、「ジャーナル・オブ・アプライド・フィジクス（J. Appl.Phys.）」第２７巻、第２６９ページ（１９８８年）などに記載されている

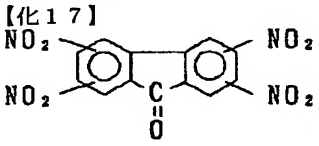
【００５８】

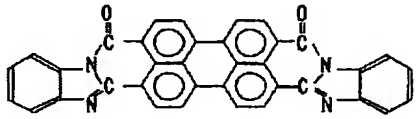
【化２１】

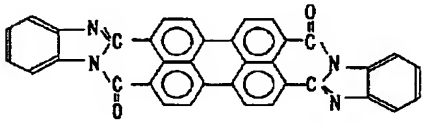
知の化合物の中から任意のものを選択して用いることができる。該電子注入材料の好ましい例としては、

【００５０】

【化１７】



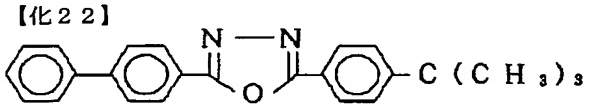




【００５９】で表される化合物、特開昭６０－６９６５７号，同６１－１４３７８４号，同６１－１４８１５９号公報などに記載されているフレオレニリデンメタン誘導体、特開昭６１－２２５１５１号，同６１－２３３７５０号公報などに記載されているアントラキノジメタン誘導体及びアントロン誘導体、「アプライド・フィジクス・レターズ（Appl. Phys. Lett.）」第５５巻，第１４８９ページ（１９８９年）に記載されている下記のオキサジアゾール誘導体

【００６０】

【化２２】

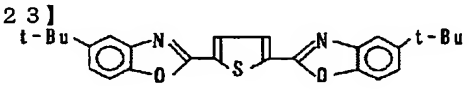


ＰＢＤ

【００６１】などを挙げることができる。また、特開昭５９－１９４３９３号公報に記載されている一連の電子伝達性化合物は、該公報では発光層を形成する材料として開示されているが、本発明者らが検討の結果、電子注入層を形成する材料として用いうることが分かった。特に

【００６２】

【化２３】



ＢＢＯＴ

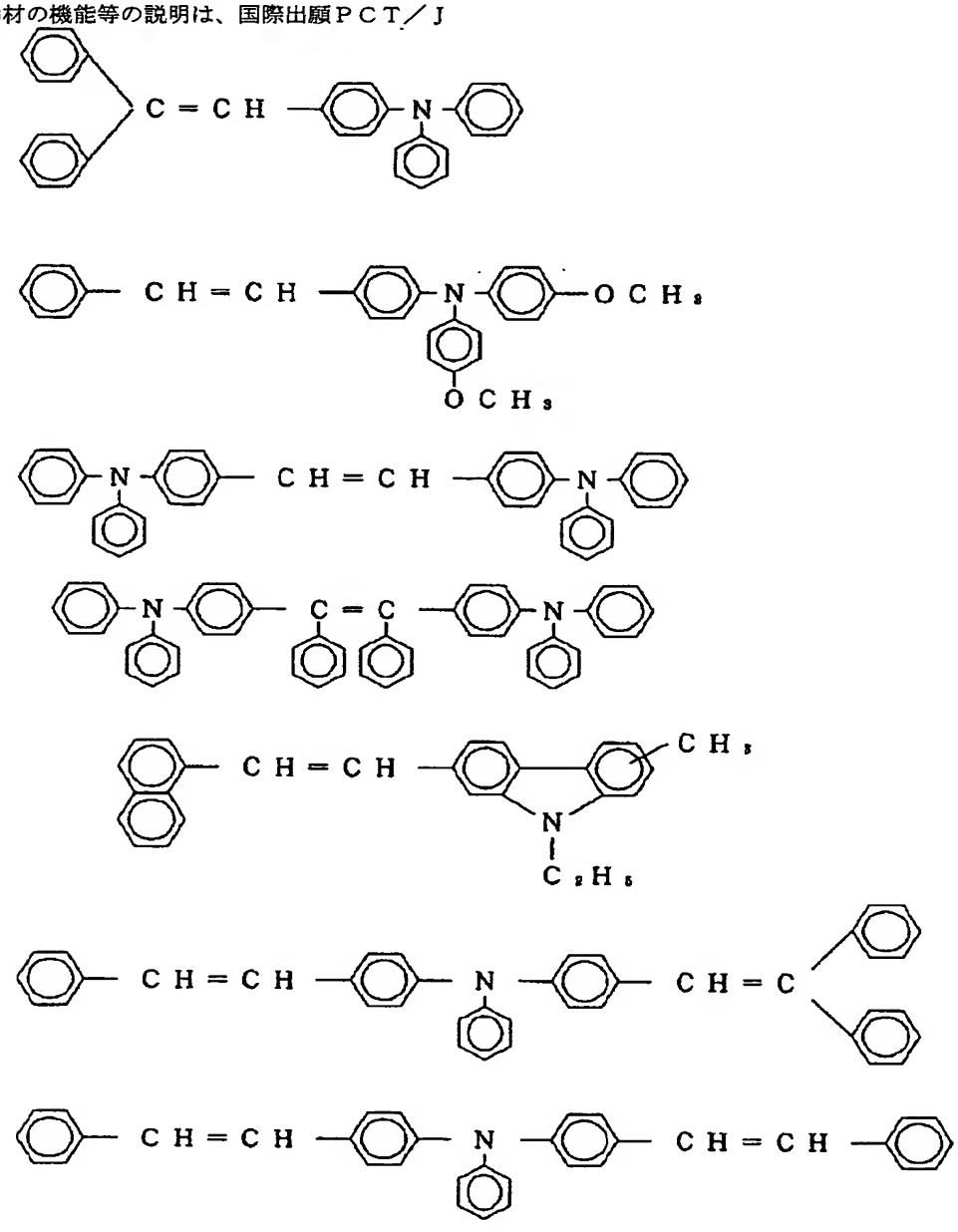
【００６３】で表される化合物が好適である。本発明の有機ＥＬ素子における電子注入層は、上記化合物を、例えば真空蒸着法，スピンコート法，キャスト法，ＬＢ法などの公知の薄膜化法により製膜して形成することができる。電子注入層としての膜厚は、通常は５ｎｍ～５μｍの範囲で選ばれる。この電子注入層は、これらの電子

単層部を用いることができる。

【００６９】本発明の有機多層部に外層部より正孔を注入する際、同じ電界強度でより電荷注入性を向上させ、より多くの電荷量を注入するために電荷注入補助材を使用してもよい。この電荷注入補助材の有機多層部の各層への添加量は、好ましくは各層の重量の１９重量％以下、特に好ましくは0.０５～９重量％である。ここで、電荷注入補助材の機能等の説明は、国際出願ＰＣＴ／ＪＰ９３／０１１９８に記載されている通りである。電荷注入補助材として用いられる電子供与性スチルベン誘導体，ジスチリルアリーレン誘導体あるいはトリススチリルアリーレン誘導体は、具体的には、次の化合物が挙げられる。

【００７０】

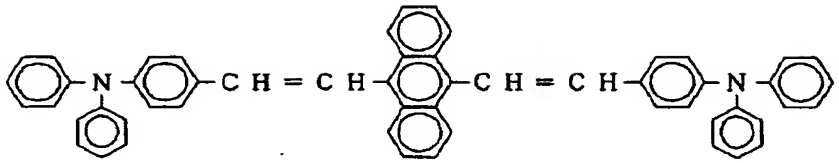
【化２６】

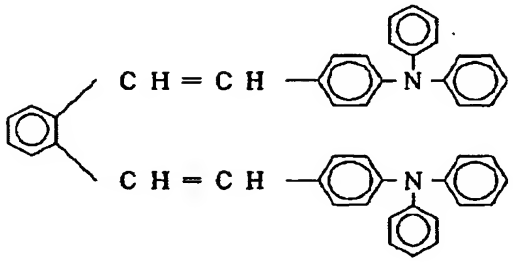


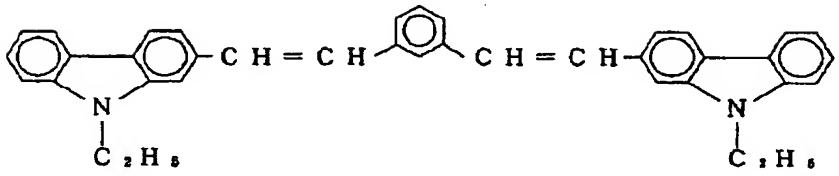
【００７１】

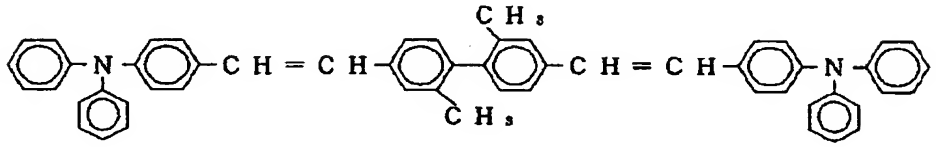
【化２７】

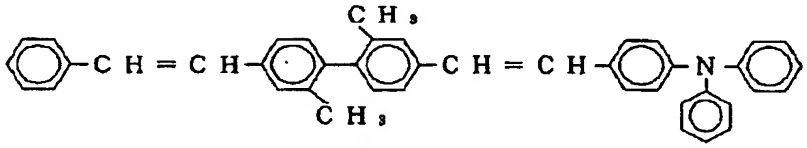
47 48







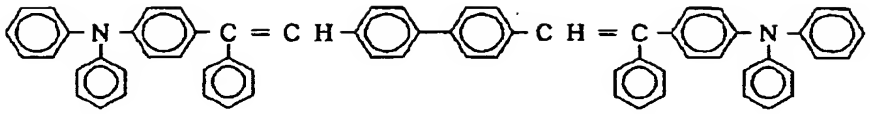


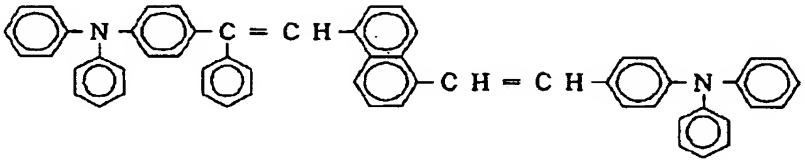


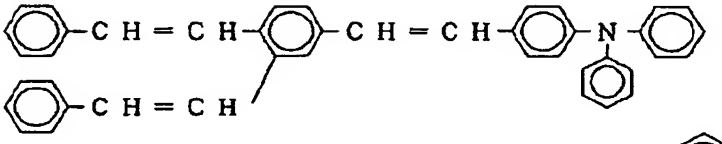
【００７３】

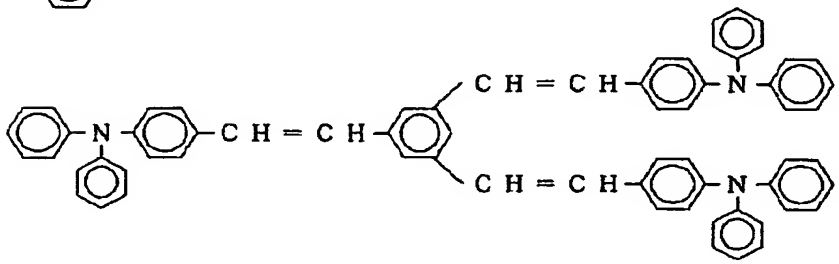
【化２９】

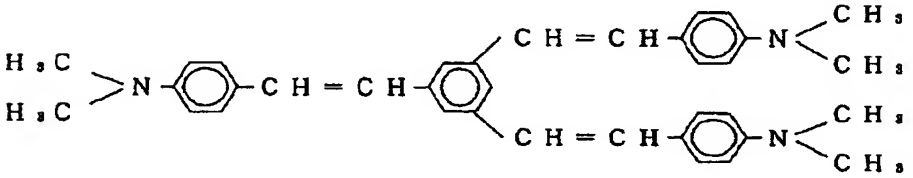
51 52





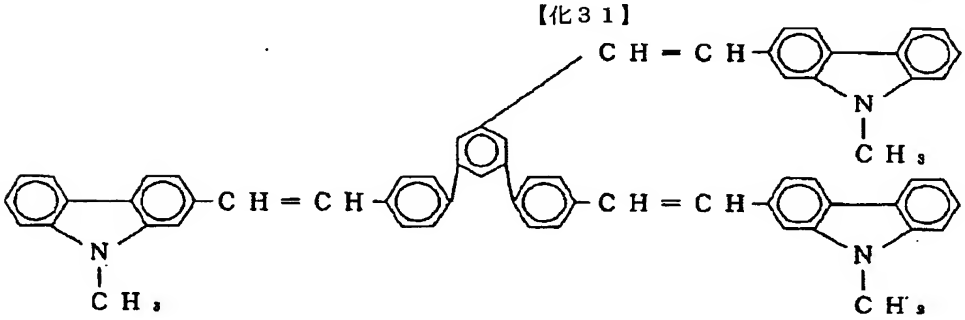


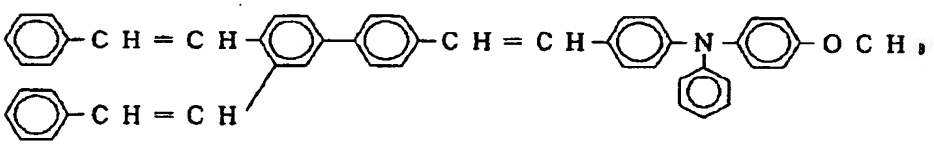


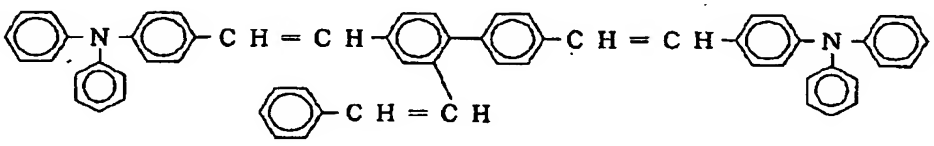


【００７５】

【化３１】



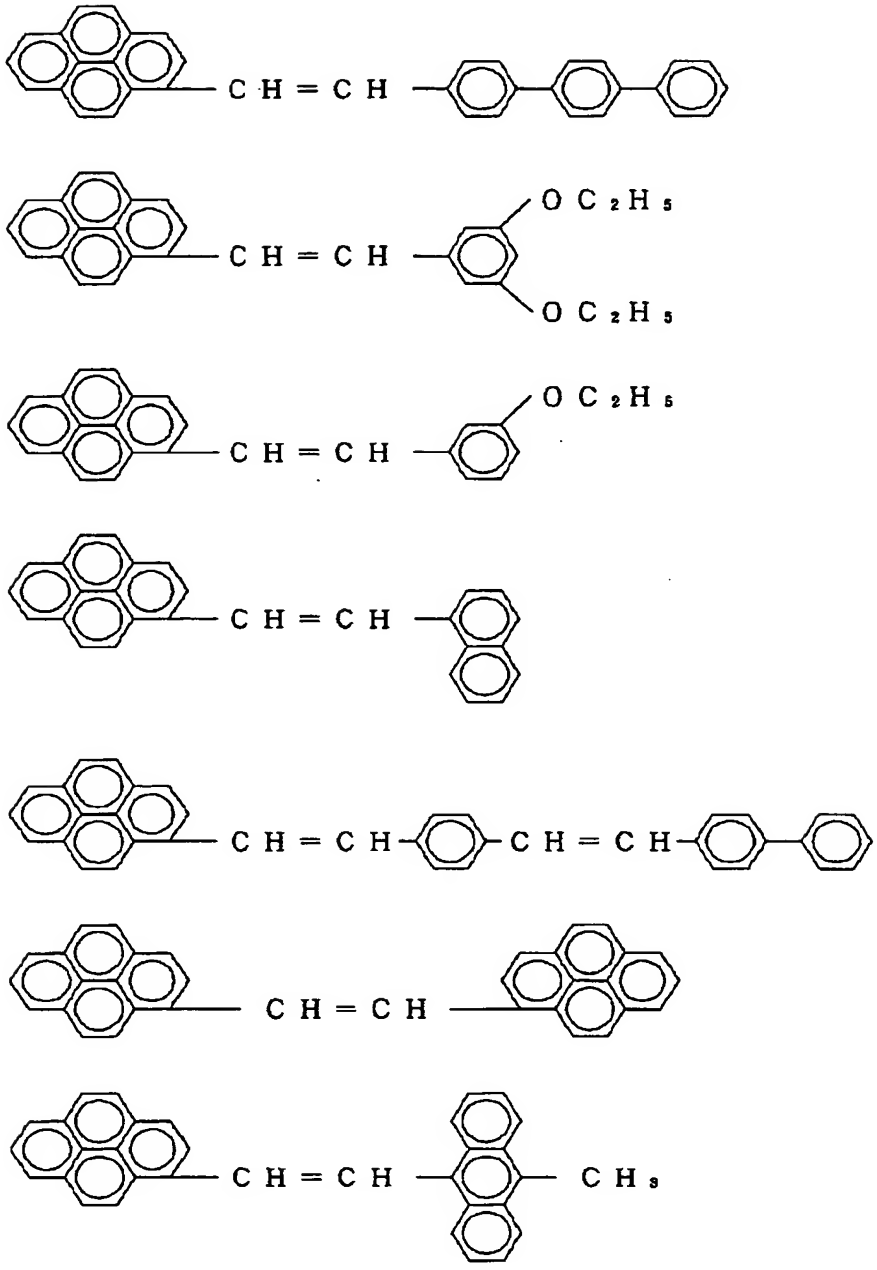




【００７６】

【化３２】

55　　56



【００７８】
【化３４】

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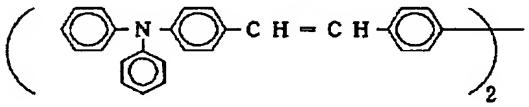
第　１　表

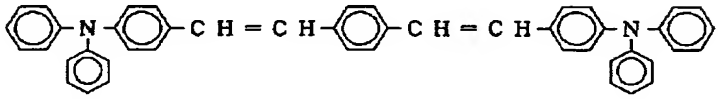
	（A）	（B）（ｎｍ／秒）	（C）（ｎｍ／秒）
実施例１	ＰＡＶＢｉ	2.8～3.5	0.075
実施例２	ＰＡＶＢ	3.2～3.4	0.10
実施例３	ＰＡＶＴＰ	2.7～3.5	0.13
比較例１	ＰＡＶＢｉ	2.5～3.0	0.09
比較例２	ＰＡＶＢ	3.0～4.0	0.09
比較例３	ＰＡＶＴＰ	2.7～3.5	0.13

【００８２】　　【化３５】

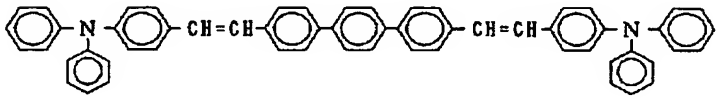
ＰＡＶＢｉ：



ＰＡＶＢ：



ＰＡＶＴＰ：



【００８３】　　【表２】

第　２　表

	各層の膜厚（ｎｍ）			
	a	b	c	d
実施例１	１２０	８０	４０	２０
実施例２	１２０	８０	４０	２０
実施例３	１００	１１０	４０	２０
比較例１	１００	６０	４０	２０
比較例２	１００	６０	４０	２０
比較例３	１００	８０	４０	２０

【００８４】　　【表３】

63　　64

第　4　表

	電　圧（V）	電流量（mA/cm²）	輝　度（cd/m²）	色　度
実施例１	8	5.14	215	(0.159, 0.192)
実施例２	8	3.0	194	(0.180, 0.275)
実施例３	8	3.38	102	(0.173, 0.181)
比較例１	6	6.9	119	(0.157, 0.242)
比較例２	8	2.58	160	(0.179, 0.326)
比較例３	8	6.67	253	(0.181, 0.215)

【００８８】対応する実施例１と比較例１、実施例２と比較例２、実施例３と比較例３とを比較して分かるように、実施例のものは、比較例のものに比べて、ｙ座標（色度）が小さくなっている。これは、実施例で規定した光学膜厚が青色の中心波長（λ）であるため、$4\pi/\lambda\,[(nd)_1+(nd)_2]=2m\pi$（ｍ＝２）の式を満足し、青色純度が高くなっていることを示している。

（３）素子のＥＬスペクトル

実施例１及び比較例１で得られた素子のＥＬスペクトルを計測した。その結果を図２に示す。図２から明らかに、実施例１では４６０ｎｍのピークが増強され、大きくなっていることが分かる。これにより、本発明の素子の構成により、青色純度が高くなっていることが示された。

【００８９】実施例４～６

（１）ＥＬ素子の作製

実施例１と同様にして、各層の膜厚が第５表に示すようなＥＬ素子を作製した。ただし、実施例４では、実施例１で用いたＩＴＯの代わりに、高屈折率1.９２のＩＴＯを用いた。また、実施例５では基板とＩＴＯ膜との間に高屈折性下地層である屈折率2.４のTiO_2層を、真空蒸着法により膜厚４８ｎｍで設けた。さらに、実施例６では基板とＩＴＯ膜との間に低屈折性下地層である屈折率1.３８のMgF_2層を、真空蒸着法により膜厚８０ｎｍで設けた。各層の膜厚を第５表に、光学膜厚，λ及びｍを第６表に示す。

【００９０】

【表６】

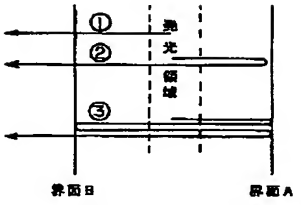
第　5　表

	各　層　の　膜　厚（ｎｍ）					
	a	b	c	d	TiO_2層	MgF_2層
実施例４	116	80	40	20	－	－
実施例５	60	80	40	20	48	－
実施例６	120	80	40	20	－	80

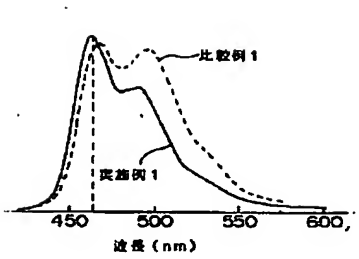
【００９１】

【表７】

【図１】



【図２】



フロントページの続き

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C09K 11/06
H05B 33/14
H05B 33/22
H05B 33/26
H05B 33/28

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(22)Date of filing : 25.02.1994

(71)Applicant : IDEMITSU KOSAN CO LTD
(72)Inventor : HOSOKAWA CHISHIO
MATSUURA MASAHIDE

(54) ORGANIC ELECTROLUMINESCENT ELEMENT

(57)Abstract:
PURPOSE: To obtain easily an organic EL element in which the color purity of the blue color luminescence is improved, by controlling the optical membrane thickness from an anode to a cathode, in a specific structure of element.
CONSTITUTION: This organic EL element is composed of a substarte; a high refractive transparent electrode; an organic multilayer; and a cathode. As the substarte, a material having a transparency, and the refractive factor 1.6 or higher, especially 1.9 or high, is preferable. The total optical membrane thickness of the electrode and the organic multilayer is necessary to set that the strength at central wavelength „ of the EL luminescence generated from the organic multilaye having the refractive factor 1.6 to 1.8 is reinforced. The electrons poured from the cathode, and the electron holes poured from the anode are combined each other, so as to produce an exciting condition of the molecules or polymers of the luminous material, and outputs the light and returns to a base condition. The difference of the refractive factors at the interface of the substarte and the high refractive factor of electrode is preferable to be large, but as the width selectable practically, it is favorable to be 0.2 to 1.5. In such an element, by controlling the optical membrane from the anode to the cathode, an organic EL element in which the color purity of the blue color luminescence is improved can be obtained.

LEGAL STATUS

[Date of request for examination]	13.05.1997
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	2846571
[Date of registration]	30.10.1998
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[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

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CLAIMS

[Claim(s)]
[Claim 1] The organic electroluminescent element which is an organic electroluminescent element which consists of a substrate / high refractility transparent electrode / the organic multilayer section / cathode, and is characterized by being set up so that the sum total optical thickness of a high refractility transparent electrode and the organic multilayer section may reinforce the reinforcement in the main wavelength lambda of the electroluminescence generated from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is chosen from 440-490nm, 500-550nm, and 600-650nm.).
[Claim 2] sum total optical thickness expresses with [(nd)1+(nd)2] — having — and formula 4 pi/lambda [(nd)1+(nd)2] =2mpi or (2m-1) pi — [— however (nd) — 1 The optical thickness of the organic multilayer section, and 2 The optical thickness of a high refractility transparent electrode and m are [a refractive index and d of the integer of 1-10 and n] thickness.] The organic electroluminescent element according to claim 1 set up so that ****** may be filled.
[Claim 3] The organic electroluminescent element according to claim 1 whose refractive index of a high refractility transparent electrode is 1.8 or more.
[Claim 4] It is the organic electroluminescent element which consists of a substrate / high refractility substrate layer / transparent electrode / the organic multilayer section / cathode. Main wavelength lambda of the electroluminescence which the sum total optical thickness of a high refractility substrate layer, a transparent electrode, and the organic multilayer section generates from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is chosen from 440-490nm, 500-550nm, and 600-650nm.) The organic electroluminescent element characterized by being set up so that the reinforcement which can be set may be reinforced.
[Claim 5] Sum total optical thickness is expressed with [(nd)1+(nd)3+(nd)4]. and formula 4 pi/lambda [(nd)1+(nd)3+(nd)4] =2mpi or (2m-1) pi — [— however (nd) — 1 The optical thickness of the organic multilayer section, and 3 The optical thickness of a transparent electrode, and 4 The optical thickness of a high refractility substrate layer and m are [a refractive index and d of the integer of 1-10 and n] thickness.] The organic electroluminescent element according to claim 4 set up so that ****** may be filled.
[Claim 6] The organic electroluminescent element according to claim 4 whose refractive index of a transparent electrode the refractive index of a high refractility substrate layer is 1.8 or more, and is 1.8 or more.
[Claim 7] The organic electroluminescent element which is an organic electroluminescent element which consists of a substrate / high refractility substrate layer / transparent electrode / the organic multilayer section / cathode, and is characterized by being set up so that the sum total optical thickness of a transparent electrode and the organic multilayer section may reinforce the reinforcement in the main wavelength lambda of the electroluminescence generated from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is chosen from 440-490mn, 500-550nm, and 600-650nm.).
[Claim 8] sum total optical thickness expresses with [(nd)1+(nd)3] — having — and formula 4 pi/lambda [(nd)1+(nd)3] =2mpi or (2m-1) pi — [— however, for the optical thickness of the organic multilayer section, and 3, the optical thickness of a transparent electrode and m are [1 / a refractive index and d of the integer of 1-10 and n] thickness.] The organic electroluminescent element according to claim 7 set up so that ****** may be filled.
[Claim 9] The organic electroluminescent element according to claim 7 whose refractive index of a transparent electrode the refractive index of a high refractility substrate layer is 1.8 or more, and is 1.8 or more.
[Claim 10] The organic electroluminescent element which is an organic electroluminescent element which consists of a substrate / low refractility substrate layer / transparent electrode / the organic multilayer section / cathode, and is characterized by being set up so that the sum total optical thickness of a transparent electrode and the organic multilayer section may reinforce the reinforcement in the main wavelength lambda of the electroluminescence generated from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is chosen from 440-490nm, 500-550nm, and 600-650nm.).
[Claim 11] sum total optical thickness expresses with [(nd)1+(nd)3] — having — and formula 4 pi/lambda [(nd)1+(nd)3] =2mpi or (2m-1) pi — [— however, for the optical thickness of the organic multilayer section, and 3, the optical thickness of a transparent electrode and m are [1 / a refractive index and d of the integer of 1-10 and n] thickness.] The organic electroluminescent element according to claim 10 set up so that ****** may be filled.
[Claim 12] The organic electroluminescent element according to claim 10 whose refractive index of a transparent electrode the refractive index of a low refractility substrate layer is 1.4 or less, and is 1.8 or more.
[Claim 13] The organic electroluminescent element according to claim 1, 4, 7, or 10 which is that in which cathode

reflects the electroluminescence generated from the organic multilayer section 50% or more.
[Claim 14] The organic electroluminescent element according to claim 1, 4, 7, or 10 whose organic multilayer section is what consists of a (a) electron hole transportation zone layer and a luminous layer, the thing which consists of (b) electron hole transportation zone layer, a luminous layer, and an electronic injection layer, or the thing which consists of (c) electron hole transportation zone layer, a luminous layer, and an adhesion improvement layer.
[Claim 15] The organic electroluminescent element according to claim 14 which reinforced the reinforcement in the main wavelength lambda of the electroluminescence generated from the organic multilayer section by selecting the thickness of the electron hole transportation zone layer in the organic multilayer section, or a luminous layer (here, lambda is 440-490nm, 500-550nm, and 600-650nm).

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] About an organic electroluminescent element (it is hereafter written as an organic EL device.), in more detail, in the component of a specific configuration, this invention controls the optical thickness from an anode plate to cathode, and relates to the organic EL device which raised especially the color purity of blue luminescence.
[0002]
[Description of the Prior Art] Generally, since its visibility is high since an EL element is self-luminous, and it is a perfect solid-state component and handling is easy while excelling in shock resistance, the utilization as a light emitting device in various displays attracts attention. Since there are an inorganic EL element which used the inorganic compound for luminescent material, and an organic EL device using an organic compound in an EL element, among these an organic EL device can make applied voltage low substantially, the utilization research is made positively. About the configuration of the above-mentioned organic EL device, the thing of configurations, such as what prepared suitably the hole-injection transporting bed and the electron injection transporting bed in this on the basis of the configuration of an anode plate / luminous layer / cathode, for example, an anode plate / hole-injection transporting bed / luminous layer / cathode, and an anode plate / hole-injection transporting bed / luminous layer / electron injection transporting bed / cathode, is known. This hole-injection transporting bed has the function to transmit the electron hole poured in from the anode plate to a luminous layer, and the electron injection transporting bed has the function to transmit the electron poured in from cathode to a luminous layer. And it is known that the electron which many electron holes were poured into the luminous layer by lower electric field, and was further poured into the luminous layer from cathode or an electron injection transporting bed by making this hole-injection transporting bed intervene between a luminous layer and an anode plate will be accumulated in the interface of a hole-injection transporting bed and a luminous layer, and luminous efficiency will go up it since a hole-injection transporting bed does not convey an electron.
[0003] In such an organic EL device, each thickness of the thickness of each class in the organic multilayer section which intervenes between an anode plate and cathode, for example, a hole-injection transporting bed, a luminous layer, and an electronic injection layer is controlled, and many attempts which obtain the maximum effectiveness and the maximum, highest brightness are made. For example, in the configuration of an anode plate / electron hole transportability luminous layer / electronic transporting bed / cathode, the thickness of an electronic transporting bed is controlled to 30-60nm, and the technique which aimed at improvement in luminous efficiency is indicated (JP,4-137485,A). This shows that the distance between a luminous layer and cathode is an important factor. Moreover, the thickness of an electronic transporting bed is controlled, and in case the light produced from a luminous layer and the light reflected from cathode interfere, the technique reinforced substantially is indicated (JP,4-328295,A).
[0004] However, in these techniques, it is not shown at all by by selecting the optical thickness of the layer containing the organic multilayer section inserted by two reflexibility interfaces that the color purity of a component is improvable. Furthermore, although it was required with these techniques to control the thickness of an electronic transporting bed, the electronic injection layer participated in luminescence in this case, color purity deteriorated, or the situation of effectiveness falling which is not desirable was invited, and that improvement was called for. Moreover, the EL element of a configuration of having inserted the metallic oxide between an anode plate and cathode is indicated (JP,4-334895,A). However, in this technique, the metal oxide layer is prepared in order to intercept the ultraviolet rays which bring about degradation of an organic layer, and the technique of this invention is not suggested. Furthermore, it is the configuration of an anode plate / hole injection layer / luminous layer / electronic injection layer / cathode, and the EL element using the mixing layer of a specific metal complex and organic compounds other than this is proposed as this electronic injection layer (Japanese Patent Application No. No. 96407 [five to]). However, in this technique, it has not set up so that the reinforcement in the wavelength from which EL light which generates the optical thickness of the organic multilayer section was selected may be reinforced, and this is not shown at all. Moreover, in the component which consists of a substrate / dielectric multilayer / transparent electrode / the organic multilayer section / cathode, the technique of raising color purity is known by controlling the sum total optical thickness of a transparent electrode and the organic multilayer section. However, it is necessary to use a dielectric multilayer and does not escape becoming cost high in this technique.
[0005] On the other hand, in the configuration of a transparent electrode / dielectric layer / fluorescent substance

layer / dielectric layer / back plate, the technique with which it was made for the thickness (d) and the refractive index of the laminating structure of a fluorescent substance layer or a fluorescent substance layer, and a dielectric layer (eta) to fill the relational expression of d=k-eta-lambda/2 (here, lambda is luminescence wavelength.) is indicated (JP,2-46695,A). The insulator layer to which inorganic fluorescent substances, such as ZnS, become a dielectric layer from an oxide etc. again is used for this fluorescent substance layer, and he is trying to interfere in the light emitted from a fluorescent substance layer in between the interface of a transparent electrode and a dielectric layer, and the interfaces of a dielectric layer and a back plate by setting up the thickness of the laminating structure of a fluorescent substance layer or a fluorescent substance layer, and a dielectric layer according to that refractive index after a multiple echo in this technique. However, with this configuration, since the refractive index of a transparent electrode is about [1.8 or less] while it is 2.0 or more, the refractive index of a dielectric layer or a fluorescent substance layer deals with the interface of this transparent electrode and a dielectric layer as reflexibility. On the other hand, in the configuration of the transparent electrode / organic multilayer section / cathode currently indicated by this invention, the refractive indexes of the organic multilayer section are 1.6-1.8, and it cannot be said that the interface of a transparent electrode and the organic multilayer section is reflexibility. Above-mentioned JP,2-46695,A does not show the interface of a transparent electrode and a substrate, the interface of a transparent electrode and a high refractility substrate layer, or the interface of a transparent electrode and a low refractility substrate layer at all like this invention about controlling the sum total optical thickness of handling and a transparent electrode, and the organic multilayer section as reflexibility.

[0006]

[Problem(s) to be Solved by the Invention] This invention is the basis of such a situation, in the component of a specific configuration, controls the optical thickness from an anode plate to cathode, and is made for the purpose of offering the organic EL device which raised especially the color purity of blue luminescence.

[0007]

[Means for Solving the Problem] this invention persons control optical thickness, and as a result of repeating research wholeheartedly that the organic EL device which raised the color purity of blue luminescence should be developed, they set in the configuration of (1) substrate / high refractility transparent electrode / organic multilayer section / cathode. The sum total optical thickness of this high refractility transparent electrode and the organic multilayer section is set in the configuration of (2) substrates / high refractility substrate layer / transparent electrode / organic multilayer section / cathode. The sum total optical thickness of this high refractility substrate layer, a transparent electrode, and the organic multilayer section Or the sum total optical thickness of a transparent electrode and the organic multilayer section is set in the configuration of (3) substrates / low refractility substrate layer / transparent electrode / organic multilayer section / cathode. It found out that the object could be attained by setting up the sum total optical thickness of this transparent electrode and the organic multilayer section so that the reinforcement in the wavelength from which EL light which emits light from the organic multilayer section with a specific refractive index was selected may be reinforced. This invention is completed based on this knowledge.

[0008] Namely, this invention is an organic EL device which consists of (1) substrate / high refractility transparent electrode / the organic multilayer section / cathode. Wavelength lambda of EL light which the sum total optical thickness of a high refractility transparent electrode and the organic multilayer section generates from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is chosen from 440-490nm, 500-550nm, and 600-650nm.) The organic EL device characterized by being set up so that the reinforcement which can be set may be reinforced [1], (2) Wavelength lambda of EL light which is the organic EL device which consists of a substrate / high refractility substrate layer / transparent electrode / the organic multilayer section / cathode, and the sum total optical thickness of a high refractility substrate layer, a transparent electrode, and the organic multilayer section generates from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is the same as the above.) The organic EL device characterized by being set up so that the reinforcement which can be set may be reinforced [2], (3) Wavelength lambda of EL light which is the organic EL device which consists of a substrate / high refractility substrate layer / transparent electrode / the organic multilayer section / cathode, and the sum total optical thickness of a transparent electrode and the organic multilayer section generates from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is the same as the above.) It is the organic EL device which consists of the organic EL device [3] characterized by being set up so that the reinforcement which can be set may be reinforced and (4) substrates / low refractility substrate layer / transparent electrode / the organic multilayer section / cathode. Wavelength lambda of EL light which the sum total optical thickness of a transparent electrode and the organic multilayer section generates from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is the same as the above.) The organic EL device [4] characterized by being set up so that the reinforcement which can be set may be reinforced is offered.

[0009] The organic EL device [1] of this invention consists of a substrate / a high refractility transparent electrode / the organic multilayer section / cathode. Although what has transparency, for example, glass, a quartz, an organic high molecular compound, etc. are mentioned as this substrate, in these, a with a refractive index of 1.6 or less thing is suitable. Moreover, as for a high refractility transparent electrode, what has the highest possible refractive index so that the echo of light may take place by the interface of a with an above-mentioned refractive index of 1.6 or less low refractility substrate and this transparent electrode is desirable, and a desirable refractive index is 1.9 or more especially preferably 1.8 or more. As such a high refractility transparent electrode, what a refractive index chooses 1.9 or more things suitably preferably, and uses as electrode material 1.8 or more is preferably used out of the dielectric large (4eV or more) transparent material, ITO, ZnO, and SnO2, of a work

function, CuI, etc. [for example,] By approaches, such as vacuum evaporationo and sputtering, by making a thin film form on a substrate, the above-mentioned electrode material is produced and this high refractility transparent electrode can carry out the thing of it. When taking out luminescence from this electrode, it is desirable to make permeability larger than 10%, and below hundreds of ohms / ** of the sheet resistance as an electrode are desirable. Furthermore, as the organic multilayer section, well-known various things can be conventionally used so that it may mention later. On the other hand, cathode is the film of mirror plane nature and what reflects more preferably EL light generated from the organic multilayer section 70% or more 50% or more is suitable for it. As such cathode, it chooses suitably from the small (4eV or less) metal of a work function, an alloy, electrical conductivity compounds, and such mixture, and what is used as electrode material is used. As an example of such electrode material, a sodium and sodium-potassium alloy, magnesium, a lithium, a magnesium-silver alloy, aluminum/aluminum 2O3, an indium, a rare earth metal, etc. are mentioned. By approaches, such as vacuum evaporationo and sputtering, this cathode can produce such electrode material by making a thin film form. Moreover, below hundreds of ohms / ** of the sheet resistance as an electrode are desirable, and especially thickness usually has the desirable range of 50-200nm 10nm - 1 micrometer.

[0010] In the organic EL device [1] of this invention, it is required to set up the sum total optical thickness of the above-mentioned high refractility transparent electrode and the organic multilayer section so that the reinforcement in the main wavelength lambda of EL light generated from the organic multilayer section of refractive indexes 1.6-1.8 may be reinforced. Here, when lambda desires blue luminescence, 440-490nm is chosen, and in the case of 500-550nm and red, it is chosen from 600-650nm when green. That is, generally it is the optical thickness of 1 and a high refractility transparent electrode about the optical thickness of the organic multilayer section 2 When it carries out, such sum total optical thickness [(nd)1+(nd)2] is formulas. 4 pi/lambda [(nd)1+(nd)2] =2mpi ... (I)
or — four — pi/lambda — [— (— nd —) — < — SUB — > — one — + — (— nd —) — two —] — = (2m-1) — pi — .. (II)
It is set up so that ****** may be filled. In the above-mentioned formula (I) and (II), a refractive index and d are thickness and the integer of 1-10 and n of m of lambda are the same as that of the above. This type (I) and (II) are chosen with the refractive index of a cathode metal. for example, — < (refractive index of the organic multilayer section) (refractive index of a cathode metal) — in the case of the reverse, a formula (I) is chosen for a formula (II), but a case is not necessarily good to examine by producing actually and to adjust a component, when the refractive index of a cathode metal does not become clear from the start. In addition, it can ask for the optical thickness of each class by the product of the thickness of the layer, and a refractive index. When the sum total optical thickness of a high refractility transparent electrode and the organic multilayer section is set up so that the above-mentioned conditions may be fulfilled, the main wavelength is reinforced and EL light which comes out from a component does so the remarkable effectiveness that color purity improves. When this effectiveness is excellent, the color of an organic EL device becomes clear, and also when realizing any of R, G, and B for being full color, it can use.

[0011] Next, the organic EL device [2] of this invention and [3] consist of a substrate / high refractility substrate layer / a transparent electrode / the organic multilayer section / cathode. The thing same as this substrate, the organic multilayer section, and cathode as what was explained with said organic EL device [1] can be used. moreover, the parenchyma top in which a high refractility substrate layer has a with a refractive indexes of 1.8 or more high refractive index — a transparent layer — it is — desirable — a refractive index — 2.0 or more oxide layers 2, for example, TiO, ZrO2, ZnO, SiO and Sc 2O3, HfO2, and CeO2 etc. — it is the layer which is known conventionally and which consists of a transparent dielectric optically. Furthermore, the layer which consists of ZnS, ZnSSe, ZnTe, GaN, InGaN, AlN, BeN, etc. is also suitable. Although what, on the other hand, uses as electrode material the dielectric transparent material illustrated as a transparent electrode in explanation of the high refractility transparent electrode of said organic EL device [1] can be used, as for the refractive index, it is advantageous that it is 1.8 or more.

[0012] It is the case where the echo of light arises in the interface of a substrate and a high refractility substrate layer in the organic EL device [2] of this invention. Therefore, main wavelength lambda of EL light which generates the sum total optical thickness of a high refractility substrate layer, a transparent electrode, and the organic multilayer section from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is the same as the above.) It is required to set up so that the reinforcement which can be set may be reinforced. That is, generally it is the optical thickness of 3 and a high refractility substrate layer about 1 and the optical thickness of a transparent electrode in the optical thickness of the organic multilayer section 4 When it carries out, Such sum total optical thickness [(nd)1+(nd)3+(nd)4] formula 4 pi/lambda [(nd)1+(nd)3+(nd)4] =2mpi ... (III) — or — 4 pi/lambda [(nd)1+(nd)3+(nd)4] =(2m-1) pi ... (IV) [— however, lambda, m, n, and d are the same as the above.] It is set up so that ****** may be filled. The above-mentioned formula (III) and (IV) It is chosen with the refractive index of a cathode metal like the case of an organic EL device [1].

[0013] On the other hand in an organic EL device [3], it is the case where the echo of light arises in the interface of a high refractility substrate layer and a transparent electrode, therefore it is required to set up the sum total optical thickness of a transparent electrode and the organic multilayer section so that the reinforcement in the main wavelength lambda of EL light generate from the organic multilayer section of refractive indexes 1.6-1.8 (it is here and lambda is the same as the above.) may be reinforce. That is, generally they are 1 and the optical thickness of a transparent electrode about the optical thickness of the organic multilayer section 3 When it carries out, such sum total optical thickness [(nd)1+(nd)3] is formulas. 4 pi/lambda [(nd)1+(nd)3] =2mpi ... (V)
or — 4 pi/lambda [(nd)1+(nd)3] =(2m-1) pi ... (VI) — [— however, lambda, m, n, and d are the same as the above.]

It is set up so that ****** may be filled. The above-mentioned formula (V) and (VI) It is chosen with the refractive index of a cathode metal like the case of an organic EL device [1]. however — < (refractive index of the organic multilayer section) (metaled refractive index) — a case — a formula (V) — moreover, in the case of the reverse, a formula (VI) is chosen.

[0014] Moreover, an echo may arise in the interface of a high refractility substrate layer and a transparent electrode, and both the interfaces of the interface of a substrate and a high refractility substrate layer. For example, it is the refractive index of the refractive-index <refractive index of high refractility substrate layer> substrate of a transparent electrode, and is the case that each refractive-index difference is large. in such a case, optical thickness — formula 4 pi/lambda 1 [(nd)1+(nd)3] =(2m-1) pi .. (VII) 4 pi/lambda 2 [(nd)1+(nd)3+(nd)4] =2mpi .. (VIII) -- [— however, m, n, and d are the same as the above.] It sets up so that ****** may be filled. The above-mentioned formula (VII) (VIII), It sets and is lambda 1. And although it is chosen from 440-490nm in the case of 500-550nm and red when blue and lambda 2 </SUB> is chosen from 600-650nm when green, it does not necessarily need to be in agreement. Moreover, formula (VII) (VIII), Like the case of said organic EL device [1], although it is the case of > (refractive index of the organic multilayer section) (refractive index of cathode), in the case of this reverse, it is a formula. 4 pi/lambda 1 [(nd)1+(nd)3] =2mpi ... (IX)

4 pi/lambda 2 [(nd)1+(nd)3+(nd)4] =(2m+1) pi ... (X)

It sets up so that ****** may be filled. Thus, above-mentioned formula (VII)/(VIII) Or when choosing formula (IX)/(X) carries out incidence of the high refractive-index side from a low refractive-index side, the phase of light is because variation is 0 in the case of the reverse pi change, although carried out. Naturally it is necessary to take change of this phase into consideration for setting out of the above-mentioned optical thickness. Especially, it is lambda1 =lambda2. Although it becomes lambda/4, in this case, it is large, and sometimes especially enhancement of the reinforcement in the main wavelength of EL light does not need to sandwich the organic multilayer section in the approach and (2) dielectric multilayer which improve color purity with the technique, for example, (nd) 4 =(1) light filter, of improving well-known color purity conventionally, and a cathode mirror plane, and does not need to use for it the approach of improving color purity etc. The organic EL device [2] of this invention and the configuration of [3] simpler than the configuration used by the above (1) and (2) are clear.

[0015] Furthermore, the organic EL device [4] of this invention consists of a substrate / low refractility substrate layer / a transparent electrode / the organic multilayer section / cathode. The thing same as this substrate, the organic multilayer section, and cathode as what was explained with said organic EL device [1] can be used. Moreover, although what uses as electrode material the dielectric transparent material illustrated as a transparent electrode in explanation of the high refractility transparent electrode of said organic EL device [1] can be used, as for the refractive index, it is advantageous that it is 1.8 or more. Furthermore, although the thing of a low refractive index can be suitably chosen as a low refractility substrate layer and can be conventionally used for it out of a well-known dielectric material, a refractive index becomes 1.4 or less and is suitable for the layer which consists of metal fluorides, such as CaF2, MgF2, and LiF, for example. Moreover, the layer which consists of fluorine-containing polymers, such as fluorination acrylic resin and a Teflon system copolymer, is also desirable. In this organic EL device [4], the echo of light arises in the interface of a low refractility substrate layer and a transparent electrode. Therefore, it is required to set up the sum total optical thickness of a transparent electrode and the organic multilayer section so that the reinforcement in the main wavelength lambda of EL light generated from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is the same as the above.) may be reinforced. That is, generally they are 1 and the optical thickness of a transparent electrode about the optical thickness of the organic multilayer section 3 When it carries out, those sum total optical thickness [(nd)1+(nd)3] is formulas. 4 pi/lambda [(nd)1+(nd)3] =2mpi ... (V)

or — 4 pi/lambda [(nd)1+(nd)3] =(2m-1) pi .. (VI) — [— however, lambda, m, n, and d are the same as the above.] It is set up so that ****** may be filled. The above-mentioned formula (V) and (VI) It is chosen with the refractive index of a cathode metal like the case of an organic EL device [1].

[0016] Next, the principle of organic EL device [1]- [4] of this invention is explained. Combining mutually the electron poured in from cathode, and the electron hole poured in from the anode plate, the excitation state of the molecule which is luminescent material, or a polymer is made, and this excitation state gives off light and returns to a ground state. When emitted, after this light was reflected by the ** interface A when being emitted from the direction of the interface B which is ** transparence, as drawing 1 R> 1 shows, and being further reflected by the ** interface B and being continuously reflected by Interface A, when emitted, various bleedoff light exists. Actually, these interfere and the multiplex interference in the so-called Fabry-Perot interference arises. As a result of such interference, in the component which fulfills the conditions of the aforementioned optical thickness, it is emitted in the form where the light of wavelength lambda (it is here and lambda is the same as the above.) was reinforced, and color purity improves. Here, although Interface A is an interface of the cathode and the organic multilayer section which have a speculum side, Interface B has the following class by the configuration of a component.

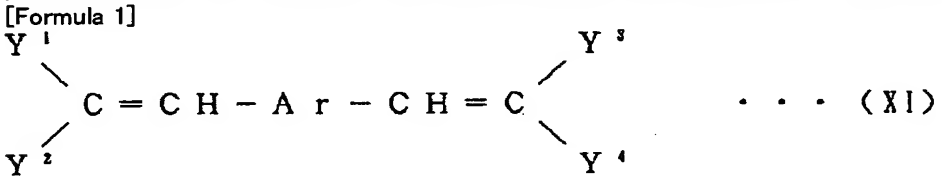
In the case of a component [1], (1) In the interface of a substrate and a high refractility transparent electrode, the case of (2) components [2] In the case of the interface of a substrate and a high refractility substrate layer, and (3) components [3], the interface of a high refractility substrate layer and a transparent electrode, (4) In the case of a component [4], the larger one of the difference (difference of the refractive index between the layers which sandwich Interface B) of the interface of a low refractility substrate layer and a transparent electrode and the refractive index in this interface B is desirable, but the width of face which can be chosen on parenchyma is 0.2-1.5 preferably. In addition, this invention does not mean using the repeat multilayer configuration of a high refractive-

index layer / low refractive-index layer for Interface B. Although it being complicated and producing to homogeneity brings about high wavelength selection a difficult top and it contributes to the improvement in color purity, such a configuration brings about the disadvantageous point that the main wavelength of EL light changes with angles of visibility rapidly simultaneously, therefore is hard to be used for a large area display device.

[0017] On the other hand, while having the property which should be observed in which the organic EL device of this invention has a small angle-of-visibility dependency, it also has the useful property in which color purity can be raised. this invention — an organic EL device — [— one —] - [— four —] — it can set — organic — a multilayer — the section — a configuration — ****** — for example — a transparent electrode — a side — from — cathode — a side — applying — (— one —) — an electron hole — a transportation zone — a layer — /— a luminous layer — (— two —) — an electron hole — a transportation zone — a layer — /— a luminous layer — /— an electronic injection layer — (— three —) — a luminous layer — /— an electronic injection layer — (— four —) — an organic semiconductor — a layer — /— a luminous layer — (— five —) — an organic semiconductor — a layer — /— an electron — a barrier layer — /— a luminous layer — (— six —) — an electron hole — a transportation zone — a layer — /— a luminous layer — /— adhesion — an improvement — a layer — In these configurations, the configuration of an electron hole transportation zone layer / luminous layer, an electron hole transportation zone layer / luminous layer / electronic injection layer, and an electron hole transportation zone layer / luminous layer / adhesion improvement layer is suitable.

[0018] In this invention, it is advantageous in the organic multilayer section of such a configuration to reinforce the reinforcement in the main wavelength lambda of EL light generated from this organic multilayer section (for it to be here and for lambda to be the same as the above.) by selecting the thickness of an electron hole transportation zone layer or a luminous layer especially. In this invention, although the refractive indexes of each class in the above-mentioned organic multilayer section may differ, respectively, the value needs to be in the range of 1.6-1.8. In addition, since the echo by the interface of a transparent electrode and the organic multilayer section has the small refractive-index difference of this transparent electrode and the organic multilayer section, there is, therefore it does not use the echo by this interface by this invention. [little] As a luminous layer in the above-mentioned organic multilayer section, it is (a) impregnation function (at the time of electrical-potential-difference impression) like the usual luminous layer. an electron hole can be poured in from an anode plate or an electron hole transportation zone layer, and an electron can be poured in from cathode or an electronic injection layer. (b) transport function (it is possible to move an electron hole and an electron according to the force of electric field.) (c) luminescence function (it is possible to offer the field of recombination of an electron hole and an electron and to make it emit light.) It has. Although the thickness of this layer does not have especially a limit and it can determine according to a situation suitably, 1nm - 10 micrometers are 5nm - 5 micrometers especially preferably preferably. Here, as a desirable luminescent material (host ingredient), it is general formula (XI) [0019].

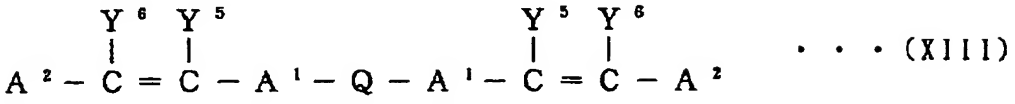
[Formula 1]



$$\begin{matrix} Y^1 & & Y^3 \\ \diagdown & & \diagup \\ & C=CH-Ar-CH=C & \\ \diagup & & \diagdown \\ Y^2 & & Y^4 \end{matrix} \qquad \cdots \quad (XI)$$

[0020] Y1 -Y4 shows among [type the aryloxy group of the carbon numbers 6-18 which are not permuted [the cyclohexyl radical which is not permuted / the aryl group of the carbon numbers 6-18 which are not permuted / a hydrogen atom, the alkyl group of carbon numbers 1-6, the alkoxy group of carbon numbers 1-6, the aralkyl radical of carbon numbers 7-8, a permutation, or /, a permutation, or /, a permutation, or], and the alkoxy group of carbon numbers 1-6, respectively. Here, a substituent shows the alkyl group of carbon numbers 1-6, the alkoxy group of carbon numbers 1-6, the aralkyl radical of carbon numbers 7-8, the aryloxy group of carbon numbers 6-18, the acyl group of carbon numbers 1-6, the acyloxy radical of carbon numbers 1-6, a carboxyl group, a styryl radical, the aryl carbonyl group of carbon numbers 6-20, the aryloxy carbonyl group of carbon numbers 6-20, the alkoxy carbonyl group of carbon numbers 1-6, a vinyl group, an ANIRINO carbonyl group, a carbamoyl group, a phenyl group, a nitro group, a hydroxyl group, or a halogen. These substituents may be single or plural is sufficient as them. Moreover, Y1 -Y4 Even if the same, you may differ mutually, and it is Y1. Y2 And Y3 Y4 It may combine with the radical permuted mutually and the saturation six membered ring which is not permuted [the saturation five membered ring which is not permuted / a permutation or /, a permutation, or] may be formed. Ar expresses the arylene radical of the carbon numbers 6-20 which are not permuted [a permutation or], and even if the single permutation is carried out, it carries out two or more permutations — having — **** — moreover, a binding site — alt., Para — meta—— any are sufficient. However, it is Y1 -Y4 when Ar is a non-permuted phenylene group. It is chosen out of the naphthyl group which is not permuted [the alkoxy group of carbon numbers 1-6, the aralkyl radical of carbon numbers 7-8, a permutation, or], a biphenyl radical, a cyclohexyl radical, and an aryloxy group, respectively.] General formula (XII) A-Q-B ... (XII) Among [type, A and B show the monad excluding one hydrogen atom from the compound expressed with the above-mentioned general formula (XI), respectively, may be the same, or may differ, and Q shows the bivalence radical which cuts conjugated system.] Or a general formula (XIII) [0021]

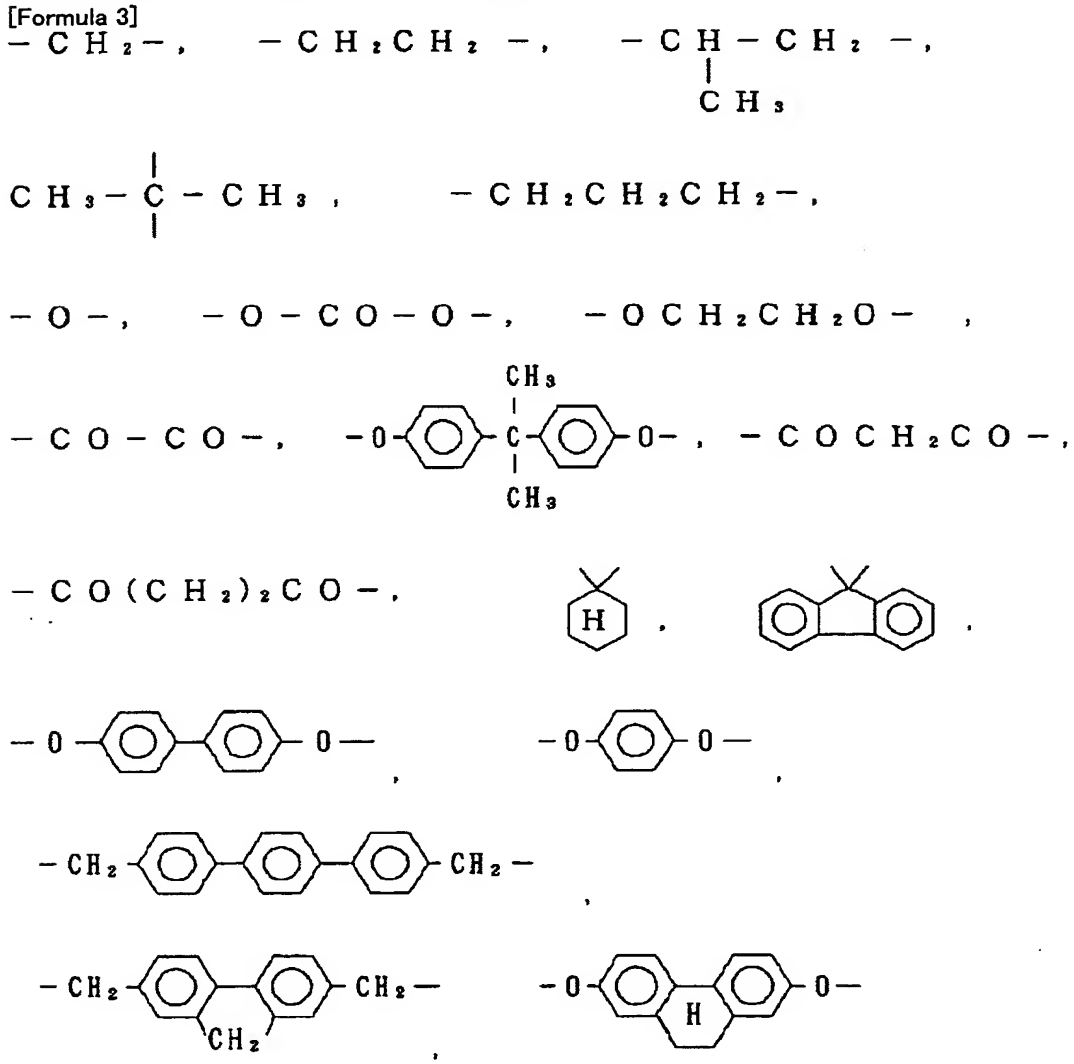
[Formula 2]



・・・(XIII)

[0022] A1 shows among [type the arylene radical of the carbon numbers 6-20 which are not permuted [a permutation or], or the aromatic heterocycle type machine of bivalence. Any of alt., meta and Para are sufficient as a joint location. A2 The aryl group of the carbon numbers 6-20 which are not permuted [a permutation or] or the aromatic heterocycle type machine of monovalence is shown. Y5 And Y6 The aryl group of the carbon numbers 6-20 which are not permuted [a hydrogen atom, a permutation, or], a cyclohexyl radical, the aromatic heterocycle type machine of monovalence, the alkyl group of carbon numbers 1-10, the aralkyl radical of carbon numbers 7-20, or the alkoxy group of carbon numbers 1-10 is shown, respectively. In addition, Y5 and Y6 It may be the same or you may differ. Here, a substituent is a phenyl group which in the case of a single permutation it does not have or it has an alkyl group, an aryloxy group, an amino group, or a substituent. Y5 Each substituent is A1. It may join together, the five membered ring or six membered ring of saturation or partial saturation may be formed, and it is Y6 similarly. Each substituent is A2. It may join together and the five membered ring or six membered ring of saturation or partial saturation may be formed. Moreover, Q expresses the bivalence radical which cuts conjugate.] It comes out and the compound expressed is mentioned. In addition, although a general formula (XII) and (XIII) Q which can be set show the bivalence radical which cuts conjugated system, conjugate contains what depends on the un-existing-locally nature of a pi electron, and is depended on conjugated double bond, an unpaired electron, or a lone-pair electrons here. As an example of Q, it is [0023].

[Formula 3]

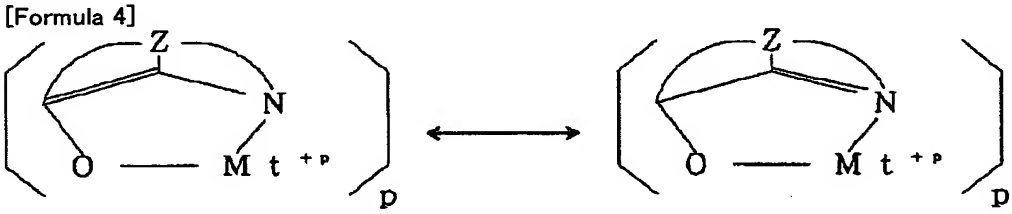


[0024] **** can be mentioned. Thus, the reason using the radical of the bivalence which cuts conjugated system is for making it EL luminescent color obtained when the compound [namely, the compound of a general formula (XI)] which forms A or B shown above is independently used as an organic EL device of this invention, and EL luminescent color obtained when ******** expressed with a general formula (XII) is used as an organic EL device of this invention not change. that is, the luminous layer using the compound expressed with a general formula (XI) or a general formula (XII) — short-wavelength-izing or a long wave — it is for merit-being made not toize. Moreover, if it

connects by the bivalence radical which cuts conjugated system, it can check going up, a uniform pinhole free-lancer's microcrystal or amorphous nature thin film can be obtained, and glass transition temperature (Tg) will raise luminescence homogeneity. Furthermore, composition or purification is equipped with the advantage made easily, without EL luminescence forming long wavelength by having joined together by the bivalence radical which cuts conjugated system. Furthermore, the metal complex of 8-hydroxyquinoline or its derivative can be mentioned as a desirable thing of luminescent material (host ingredient). Specifically, it is a metal chelate oxy-NOIDO compound containing the chelate of an oxine (generally an eight quinolinol or 8-hydroxyquinoline). Such a compound shows the engine performance of a high level, and is easily fabricated by the thin film gestalt. the example of an oxy-NOIDO compound is ** which fills the following structure expression.

[0025]

[Formula 4]

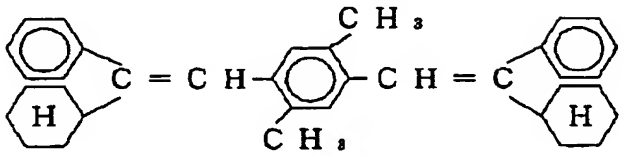


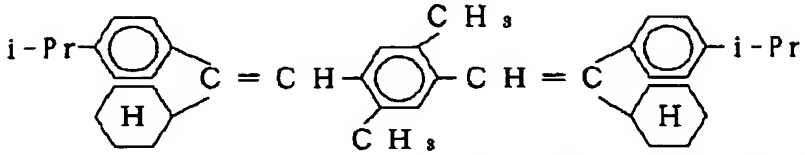
[0026] Mt expresses a metal among [type and an atom required in order for p to be the integer of 1-3, and for each of the location of Z to be independent and to complete at least two or more fused aromatic rings is shown.] Here, the metals expressed with Mt are earth metals, such as alkaline earth metal, such as alkali metal, such as monovalence, bivalence or a trivalent metal, for example, a lithium, sodium, or a potassium, magnesium, or calcium, boron, or aluminum. Each the monovalence, the bivalence, or the trivalent metal known as it is generally a useful chelate compound can be used. Moreover, Z shows the atom in which the heterocycle which one side of at least two or more fused aromatic rings becomes from azole or an azine is made to form. Here, if required, it is possible to add the ring from which others differ to the above-mentioned fused aromatic ring. Moreover, in order to avoid adding a ******** molecule, with no improvement on a function, as for the number of the atoms shown by Z, carrying out to 18 or less is desirable. Furthermore, if a chelation oxy-NOIDO compound is illustrated concretely Tris Aluminum, a screw (Eight quinolinol) Magnesium, a screw (Eight quinolinol) Zinc, a screw (Benzo-eight quinolinol) (2-methyl-8-quinolilato)aluminumoxide, a tris (eight quinolinol) indium, tris (5-methyl-eight quinolinol) aluminum, an eight-quinolinol lithium, a tris (5-chloro-eight quinolinol) gallium, a screw (5-chloro-eight quinolinol) There are calcium, 5, 7-dichloro-eight-quinolinol aluminum, tris (5, 7-dibromo-8-hydroxy quinolinol) aluminum, etc.

[0027] as the formation approach of the above-mentioned luminous layer — vacuum deposition, a spin coat method, the cast method, and LB — although it can form by thin-film-izing by well-known approaches, such as law, it is desirable that it is especially the molecule deposition film. Here, molecule deposition film is the thin film which deposition was carried out and was formed from the gaseous-phase condition of this compound, and film solidified and formed from the melting condition or liquid phase condition of this compound. usually, this molecule deposition film — LB — it is distinguishable with the thin film (molecule built up film) formed of law, and the difference of condensation structure and higher order structure and the functional difference resulting from it. Moreover, after it melts the above-mentioned luminous layer to a solvent and it considers as a solution with binding material, such as resin, it can thin-film-ize this with a spin coat method etc., and can form it. The following compounds are mentioned as an ingredient of the luminous layer expressed with said general formula (XI) - (XIII).

[0028]

[Formula 5]





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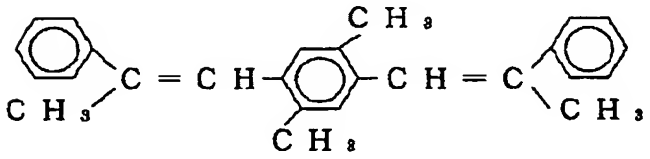
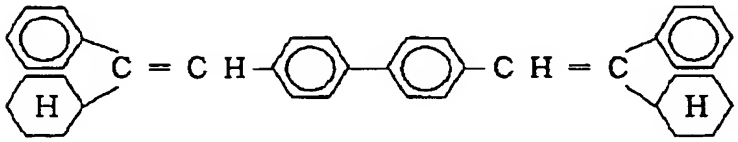
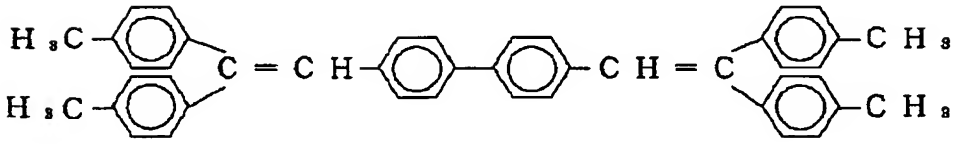
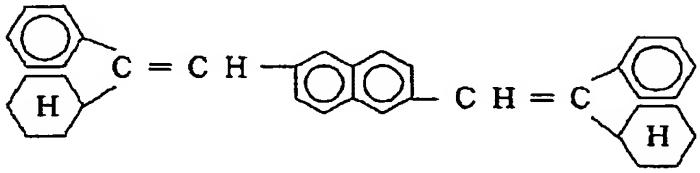
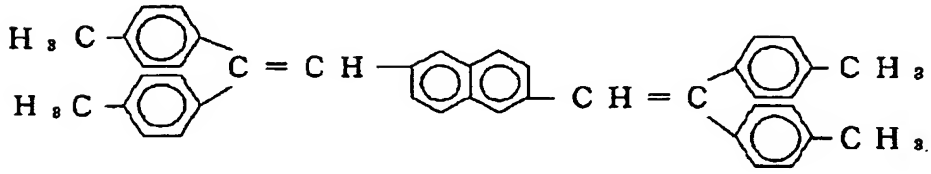


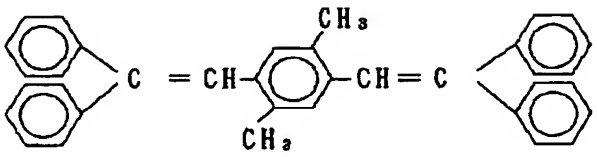


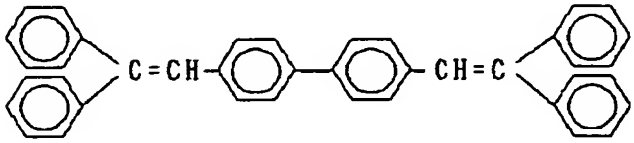


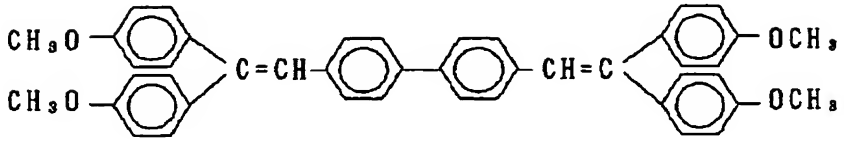


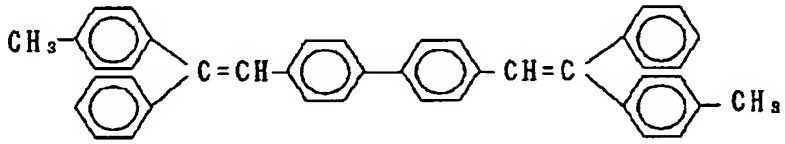


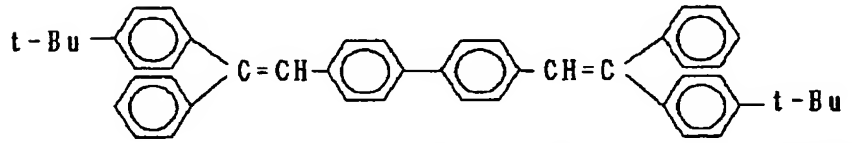
[0029]
[Formula 6]











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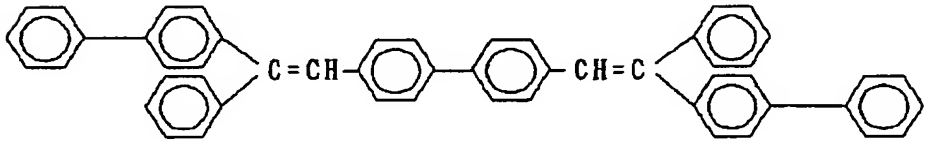
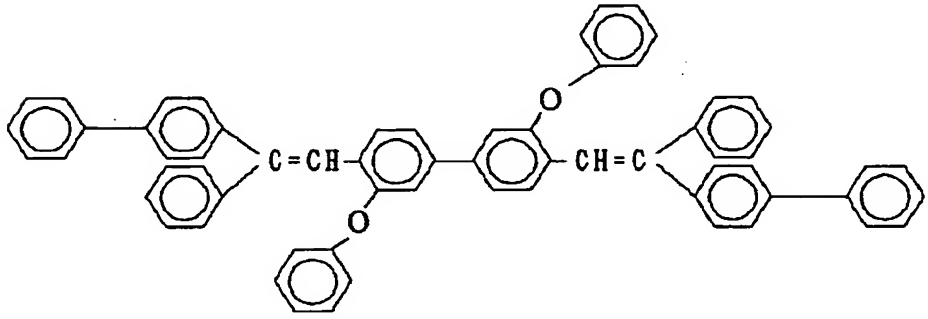
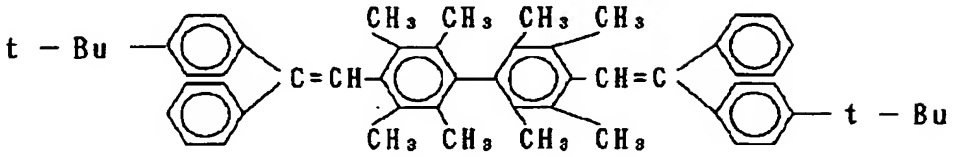
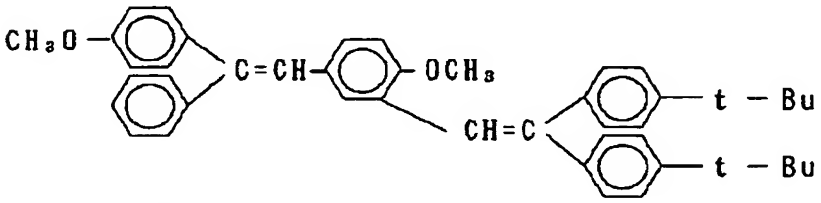
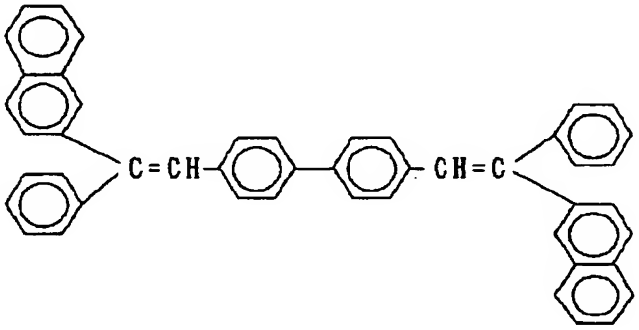


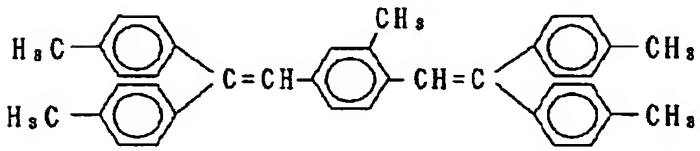


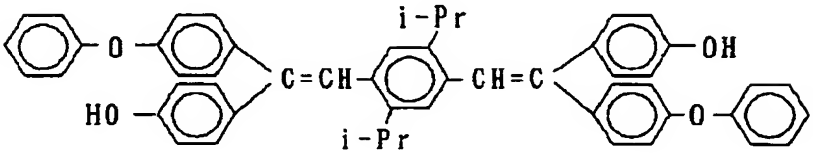
[0030]
[Formula 7]

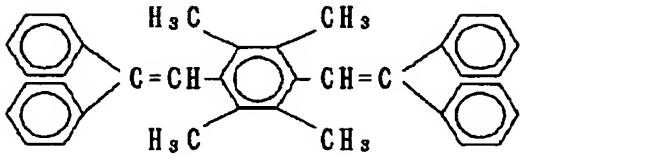




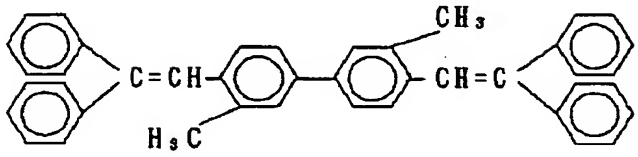


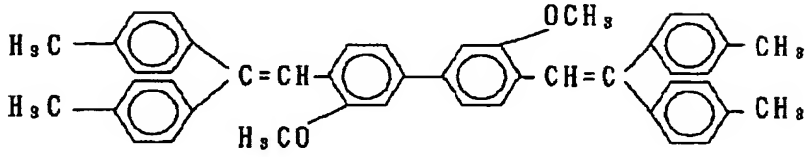


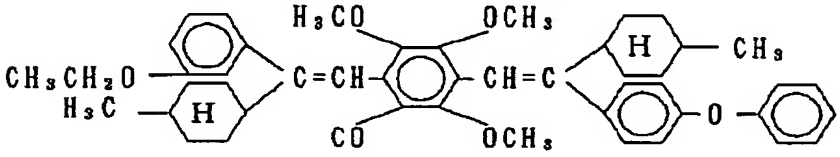


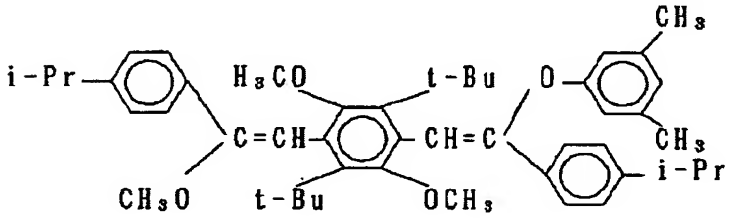


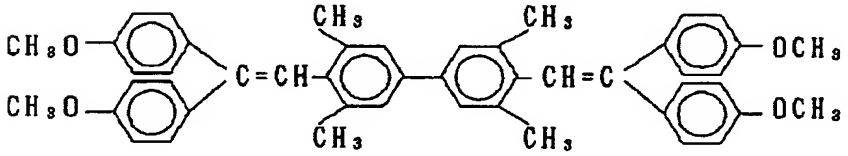
[0031]
[Formula 8]

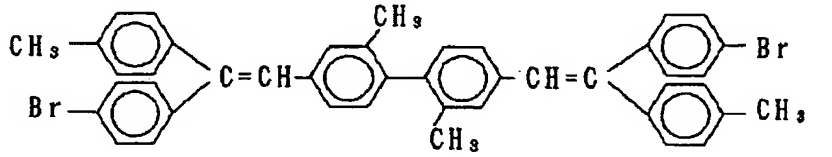




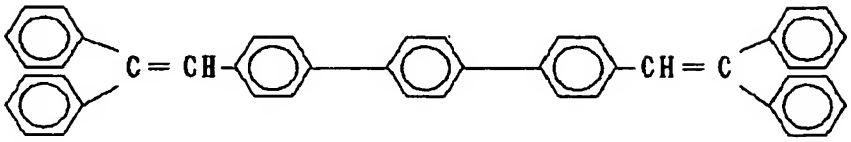


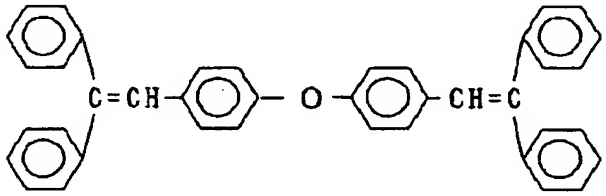


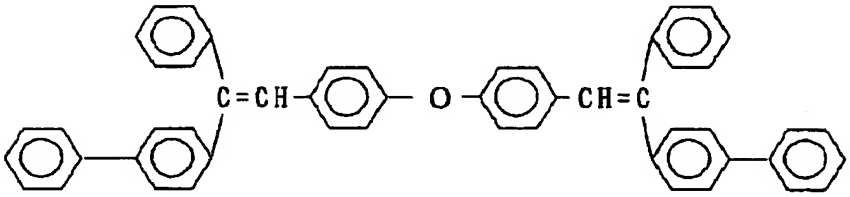


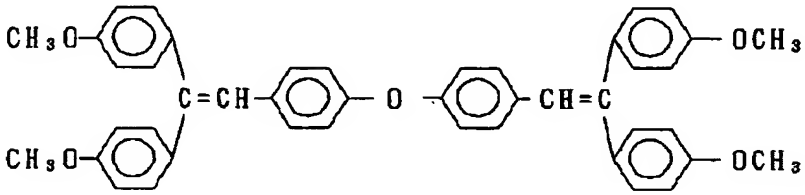


[0032]
[Formula 9]

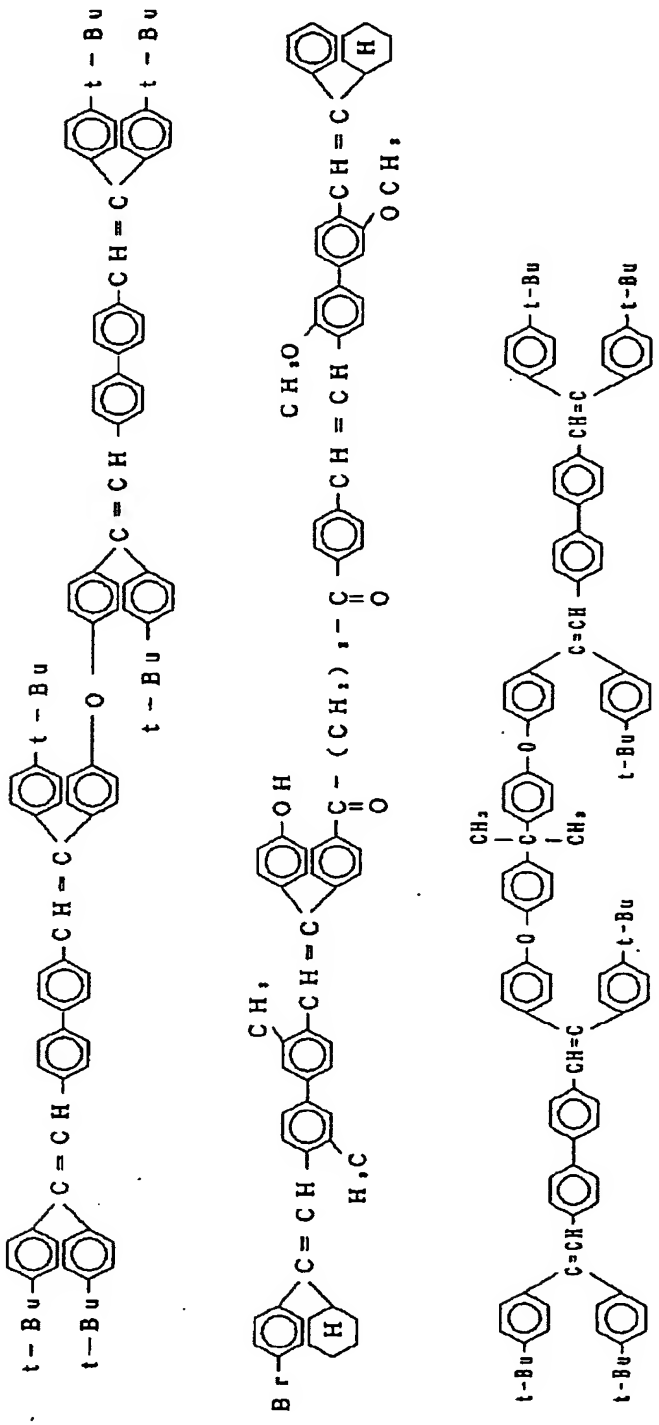




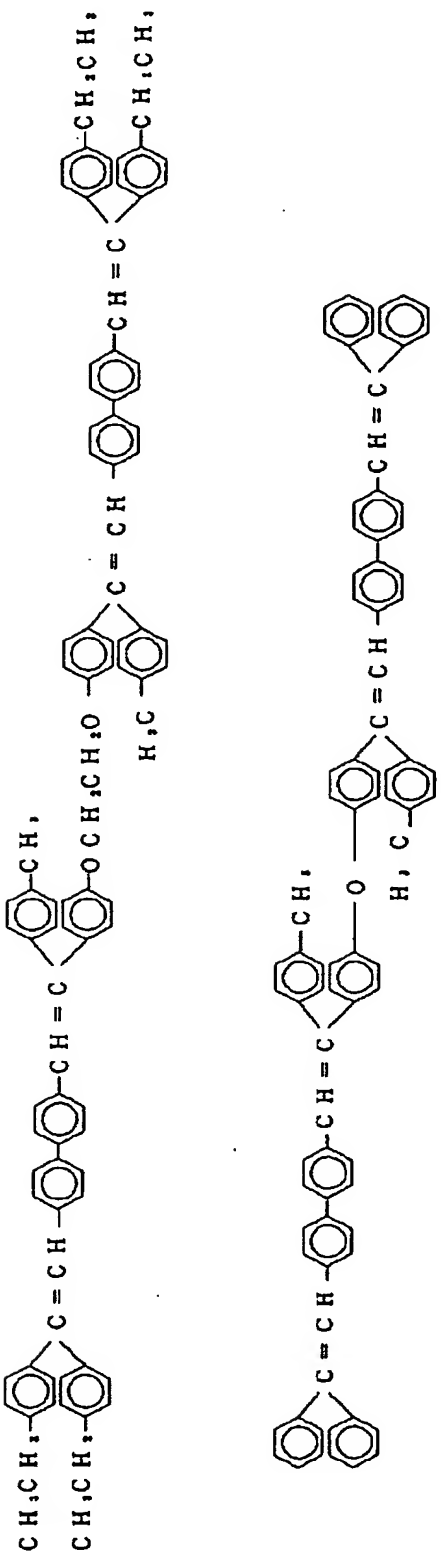




[0033]
[Formula 10]



[0034]
[Formula 11]



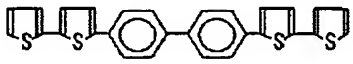
[0035] Next, although an electron hole transportation zone layer is not necessarily required for this component, it is more desirable to use for improvement in the luminescence engine performance. The ingredient which conveys an electron hole to a luminous layer by lower electric field as this electron hole transportation zone layer is desirable, and at the time of electric-field impression of 104 - 106 V/cm, if the mobility of an electron hole is 10-6cm2 / V; and a second at least, in addition, it is still more desirable. Moreover, since the electron is stopped in the luminous layer, an electronic barrier layer can be used between a luminous layer and an anode plate (transparent electrode). About such an electron hole transport ingredient, if it has the aforementioned desirable property, there is especially no limit, and it can choose and use the thing of arbitration in photoconductive material conventionally out of what is commonly used as charge transport material of an electron hole, or the well-known thing used for the electron hole

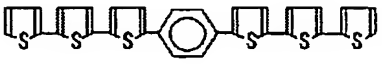
transportation zone layer of an EL element.
[0036] As this electron hole transport ingredient, for example A triazole derivative (reference, such as a U.S. Pat. No. 3,112,197 description), An OKISA diazole derivative (reference, such as a U.S. Pat. No. 3,189,447 description), An imidazole derivative (reference, such as JP,37-16096,B), the poly aryl alkane derivative (the [United States patent] — 3,615,402) a number description — this 3,820,989 a number description — this 3,542,544 Reference, such as a number description, JP,45-555,B, a 51-10983 official report, JP,51-93224,A, a 55-17105 official report, a 56-4148 official report, a 55-108667 official report, a 55-156953 official report, and a 56-36656 official report, A pyrazoline derivative and a pyrazolone derivative (the [United States patent] — 3,180,729) a number description — this 4,278,746 A number description, JP,55-88064,A, a 55-88065 official report, a 49-105537 official report, a 55-51086 official report, a 56-80051 official report, a 56-88141 official report, a 57-45545 official report, a 54-112637 official report, Reference, such as a 55-74546 official report, A phenylenediamine derivative (reference, such as a U.S. Pat. No. 3,615,404 description, JP,51-10105,B, a 46-3712 official report, a 47-25336 official report, JP,54-53435,A, a 54-110536 official report, and a 54-119925 official report), an arylamine derivative (the [United States patent] — 3,567,450) a number description — this 3,180,703 a number description — this 3,240,597 a number description — this 3,658,520 a number description — this 4,232,103 a number description — this 4,175,961 a number description — said — 4,012,376 A number description, JP,49-35702,B, a 39-27577 official report, JP,55-144250,A, a 56-119132 official report, a 56-22437 official report, and West German patent 1,110,518th Reference, such as a number description An amino permutation chalcone derivative (reference, such as a U.S. Pat. No. 3,526,501 description), An oxazole derivative (thing given in a U.S. Pat. No. 3,257,203 description etc.), A styryl anthracene derivative (reference, such as JP,56-46234,A), full — me — non — a derivative (reference, such as JP,54-110837,A) — a hydrazone derivative (the [United States patent] — 3,717,462) Reference, such as a number description, JP,54-59143,A, a 55-52063 official report, a 55-52064 official report, a 55-46760 official report, a 55-85495 official report, a 57-11350 official report, and a 57-148749 official report, A stilbene derivative JP,61-210363,A, a 61-228451 official report, a 61-14642 official report, a 61-72255 official report, a 62-47646 official report, a 62-36674 official report, a 62-10652 official report, and a 62-30255 official report — Reference, such as a 60-93445 official report, a 60-94462 official report, a 60-174749 official report, and a 60-175052 official report, etc. can be mentioned. furthermore, a silazane derivative (U.S. Pat. No. 4,950,950 description), a polysilane system (JP,2-204996,A), an aniline system copolymer (JP,2-282263,A), and conductive polymer oligomer (publication-number 1-No. 211399 official report) — ** thiophene oligomer etc. is mentioned especially.
[0037] In this invention, although these compounds can be used as an electron hole transport ingredient The porphyrin compound shown below (thing given in JP,63-2956965,A etc.), An aromatic series tertiary-amine compound and a styryl amine compound (the [United States patent] — 4,127,412) A number description, JP,53-27033,A, a 54-58445 official report, a 54-149634 official report, a 54-64299 official report, a 55-79450 official report, a 55-144250 official report, a 56-119132 official report, a 61-295558 official report, It is desirable reference, such as a 61-98353 official report and a 63-295695 official report, and to use this aromatic series tertiary-amine compound especially. As an example of representation of this porphyrin compound Porphin, 1, 10 and 15, 20-tetrapod phenyl-21H, 23H-porphin copper (II);1, 10 and 15, 20-tetrapod phenyl 21H, 23H-porphin zinc (II);5, 10 and 15, 20-tetrakis (pentafluorophenyl)-21H, 23H-porphin; Silicon phthalocyanine oxide; Aluminum phthalocyanine chloride; A phthalocyanine ; (Non-metal) Dilithium phthalocyanine; copper tetramethyl phthalocyanine; — copper-phthalocyanine; — chromium phthalocyanine; — zinc phthalocyanine; — lead phthalocyanine; — titanium phthalocyanine oxide; — magnesium phthalocyanine; — a copper octamethyl phthalocyanine etc. is mentioned.
[0038] moreover, as an example of representation of this aromatic series tertiary-amine compound and a styryl amine compound N, N, N', and N' - tetra-phenyl - 4 and 4 - diamino phenyl, and 'N, N' - diphenyl-N and N' - JI (3-methylphenyl) -4 and 4' — a - diamino biphenyl, 2, and 2-bis(4-G p-tolylamino phenyl) propane and 1 — 1-screw (4-G p-tolylamino phenyl) a cyclohexane, N and N, N', and N' — the - tetra--p-tolyl -4 and 4' - diamino biphenyl, 1, and 1-bis(4-G p-tolylamino phenyl)-4-phenylcyclohexane — a screw (4-dimethylamino-2-methylphenyl) a phenylmethane, a bis(4-G p-tolylamino phenyl) phenylmethane, N, and N' - diphenyl-N and N' - JI (4-methoxypheny) - 4 and 4 - diamino biphenyl, and 'N, N, N' — N'-tetrapod phenyl -4, 4'-diamino diphenyl ether, 4, and 4 '- bis(diphenylamino) KUODORI phenyl, N and N, N-Tori (P-tolyl) amine, and 4-(G p-tolylamino)-4'-[4 (G p-tolylamino) Styryl] stilbene, 4-N and N-diphenylamino-(2-diphenyl vinyl) benzene, 3-methoxy-4'-N, and N-diphenylamino still benzene, N-phenyl carbazole, an aromatic series JIMECHIRI DIN system compound, etc. are mentioned.
[0039] this electron hole transportation zone layer in the EL element of this invention — the above-mentioned compound — for example, a vacuum deposition method, a spin coat method, and LB — a film can be produced with well-known film methods, such as law, and it can form. The thickness of this electron hole transportation zone layer is usually 5nm - 5 micrometers, although there is especially no limit. This electron hole transportation zone layer may consist of one layer which consists of the above-mentioned electron hole transport ingredient kinds or two sorts or more, or may carry out the laminating of the electron hole transportation zone layer which consists of a compound of another kind to said electron hole transportation zone layer.
[0040] Furthermore, as an ingredient of an organic-semiconductor layer, it is [0041], for example.
[Formula 12]

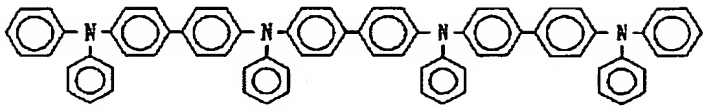
(1) 

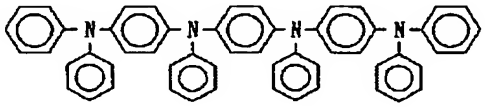
(2) 

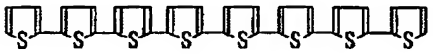
(3) 

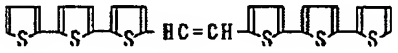
(4) 

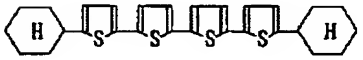
(5) 

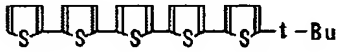
(6) 

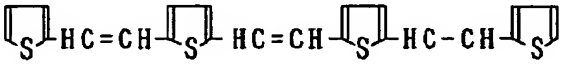
(7) 

(8) 

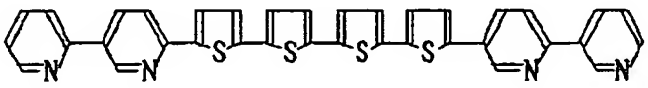
(9) 

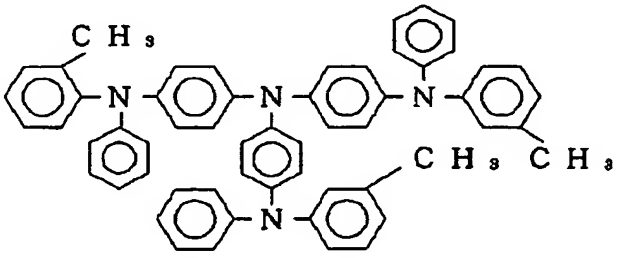
(10) 

(11) 

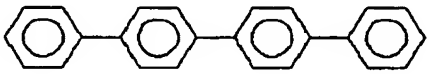
[0042]
[Formula 13]
(12) 

(13) 

(14) 

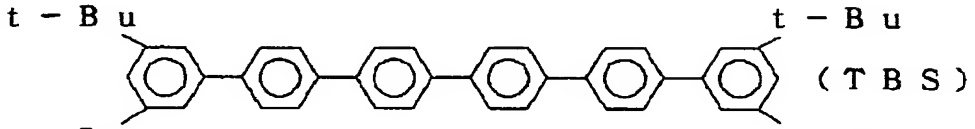
(15) 

[0043] **** can be mentioned.
[0044] On the other hand, as an ingredient of an electronic barrier layer, it is [0045], for example.
[Formula 14]
(1)



(2)

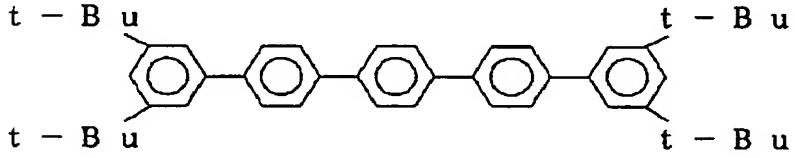
(3)



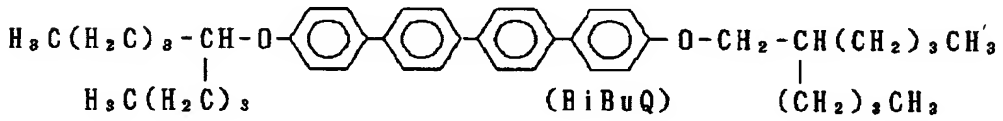
(TBS)

(t-Bu: ターシャリーブチル基)

(4)

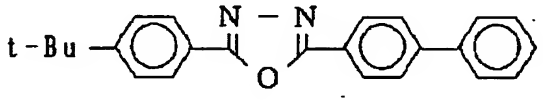


(5)



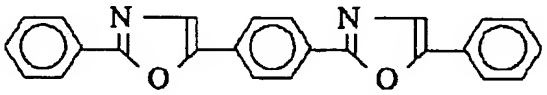
(BiBuQ)

(6)

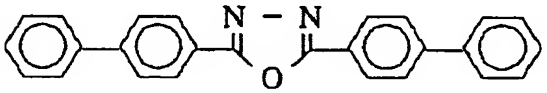


(t-Bu PBD)

(7)

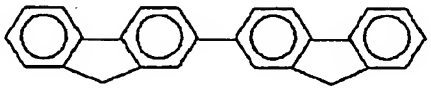


(8)

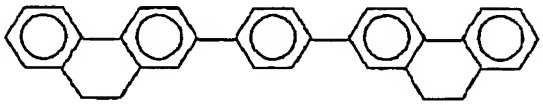


[0046]
[Formula 15]

(9)

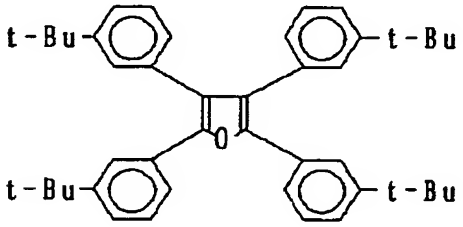


(10)

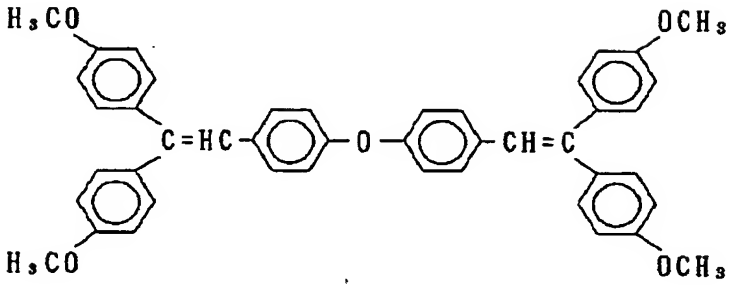


(11)

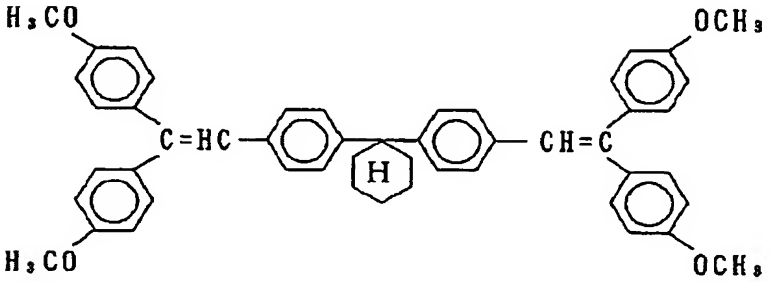
(12)



(13)



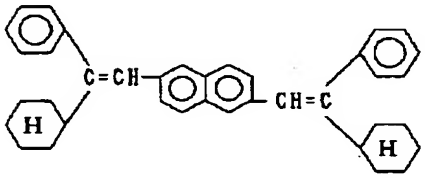
(14)



[0047]
[Formula 16]

(15)

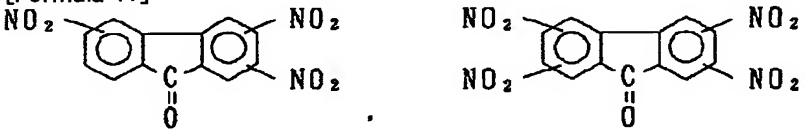
(16)



[0048] **** can be mentioned.

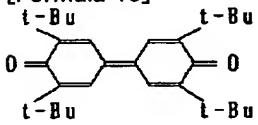
[0049] Moreover, the electronic injection layer in this organic multilayer section consists of an electron injection ingredient, and it has the function to be at a luminous layer and to transmit the electron poured in from cathode. There is especially no limit about such an electron injection ingredient, and the thing of arbitration can be conventionally chosen and used out of a well-known compound. As a desirable example of this electron injection ingredient, it is [0050].

[Formula 17]



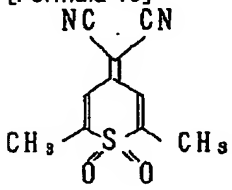
[0051] which nitration full — me — non — the anthra quinodimethan derivative indicated by a derivative, JP,57-149259,A, 58-55450, the 63-104061 official report, etc., and "polymer pre PURINTSU and Japan (Polymer Preprints, Japan)" — [0052] indicated by the 37th volume, No. 3, the 681st page (1988), etc.

[Formula 18]



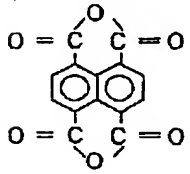
[0053] Which diphenyl quinone derivative [0054]

[Formula 19]



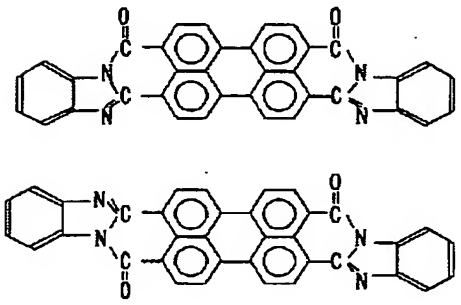
[0055] Which thiopyran dioxide derivative [0056]

[Formula 20]



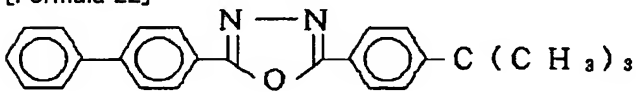
[0057] Heterocycle tetracarboxylic acid anhydrides, such as which naphthalene perylene, or a carbodiimide is mentioned. furthermore, "Journal of Applied Physics (J.Appl.Phys.)" — [0058] indicated by the 27th volume, the 269th page (1988), etc.

[Formula 21]



[0059] the anthra quinodimethan derivative indicated by the deflection ORENIRIDEN methane derivative which comes out and is indicated by the compound and JP,60-69657,A which are expressed, 61-143784, the 61-148159 official report, etc., JP,61-225151,A, the 61-233750 official report, etc. and an anthrone derivative, and "applied FIJIKUSU Letters (Appl.Phys.Lett.)" — the 55th volume and the following OKISA diazole derivative [0060] indicated by the 1489th page (1989)

[Formula 22]

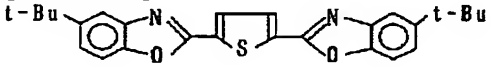


P B D

[0061] **** can be mentioned. Moreover, although a series of electron transport nature compounds indicated by JP,59-194393,A were indicated in this official report as an ingredient which forms a luminous layer, examination of this invention persons showed that it could use as an ingredient which forms an electronic injection layer. It is

[0062] especially.

[Formula 23]

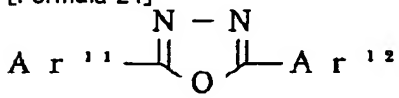


B B O T

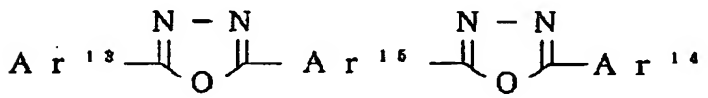
[0063] It comes out and the compound expressed is suitable. the electronic injection layer in the organic EL device of this invention — the above-mentioned compound — for example, a vacuum deposition method, a spin coat method, the cast method, and LB — a film can be produced by the thin film-ized method law etc. is well-known, and it can form. The thickness as an electronic injection layer is usually chosen in 5nm - 5 micrometers. This electronic injection layer may consist of one layer which consists of these electron injection ingredient kinds or two sorts or more, or may carry out the laminating of the electronic injection layer which consists of a compound of another kind to this layer.

[0064] Furthermore, what is excellent in electron transport nature, and contains an adhesive high ingredient to a luminous layer and cathode as an adhesion improvement layer in this organic multilayer section is desirable. As such an ingredient, the metal chelate oxy-NOIDO compound which contains 8-hydroxyquinoline or the metal complex of the derivative, for example, the chelate of an oxine (generally an eight quinolinol or 8-hydroxyquinoline), for example is mentioned. Specifically, the complex of indiums other than aluminum, magnesium, copper, a gallium, tin, and lead etc. can be mentioned to tris (eight quinolinol) aluminum, tris (5, 7-dichloro-eight quinolinol) aluminum, tris (5, 7-dibromo-eight quinolinol) aluminum, tris (2-methyl-eight quinolinol) aluminum, and a list. Moreover, an OKISA diazole derivative is also suitable and they are a general formula (XIV) and (XV) [0065] as this OKISA diazole derivative.

[Formula 24]



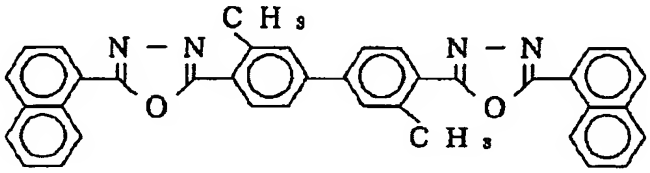
・・・ (XIV)

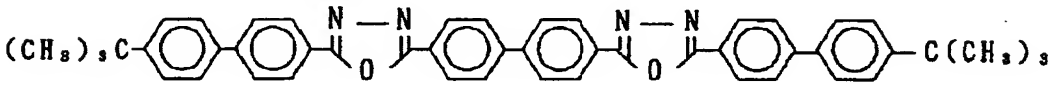


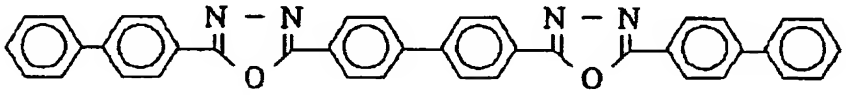
・・・ (XV)

[0066] Ar11-Ar14 show among [type the aryl group which is not permuted [a permutation or], respectively, even if Ar11, Ar12, and Ar13 and Ar14 are mutually the same in each, you may differ, and Ar15 shows the arylene radical which is not permuted [a permutation or].] It comes out and the electron transport compound expressed is mentioned. Here, as an aryl group, a phenyl group, a biphenyl radical, an anthranil, a peri RENIRU radical, a pyrenyl radical, etc. are mentioned, and a phenylene group, a naphthylene radical, a biphenylene radical, an anthracenylene group, a peri RENIREN radical, a pyrenylene radical, etc. are mentioned as an arylene radical. Moreover, as a substituent, the alkyl group of carbon numbers 1-10, the alkoxy group of carbon numbers 1-10, or a cyano group is

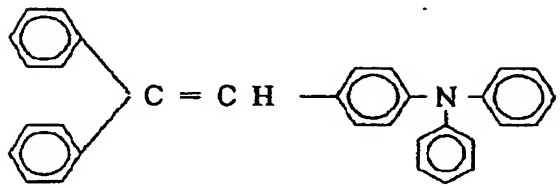
mentioned. This electron transport compound has the desirable thing of a thin film plasticity. The above mentioned PBD is begun as an example of this electron transport compound, and it is [0067].
[Formula 25]

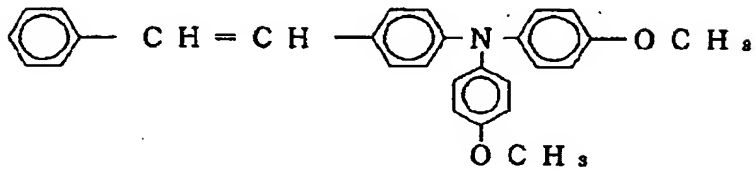


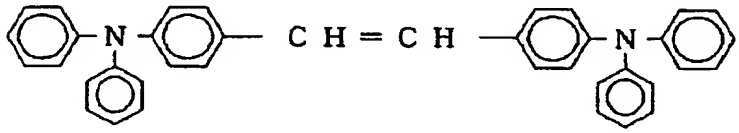


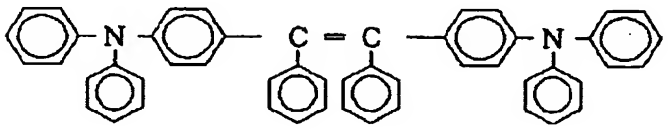


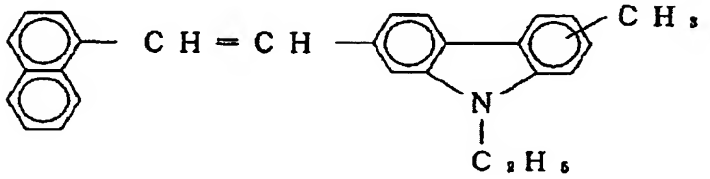
[0068] It comes out and the compound expressed is mentioned. the adhesion improvement layer in the organic EL device of this invention — the above-mentioned compound — for example, a vacuum deposition method, a spin coat method, the cast method, and LB — a film can be produced by the thin film-ized method law etc. is well-known, and it can form. The thickness as an adhesion improvement layer is usually chosen in 5nm - 5 micrometers. This adhesion improvement layer may consist of one layer which consists of these adhesive ingredient kinds or two sorts or more, or may carry out the laminating of the adhesion improvement nature which consists of a compound of another kind to this layer. such an adhesion improvement layer consists of an adhesive high electron transport compound, and comes out not to mention playing a role of an electronic injection layer. In addition, the technique which monolayer-izes the organic multilayer section is well-known, and in this technique, an electron hole transport ingredient, luminescent material, an electron injection ingredient, etc. are mixed, for example in binders, such as polystyrene, a polycarbonate, and a polyvinyl carbazole, it equalizes, and the monolayer which consists of this thing is made to form between an anode plate (transparent electrode) and cathode. This monolayer-ized technique is indicated by the 40th volume and the 3591st page for example, in "collection of Japanese Society of Polymer Science, Japan drafts" 1991. In this invention, it can replace with the organic multilayer section and the organic monolayer section by this technique can be used.
[0069] In case an electron hole is poured into the organic multilayer section of this invention from the outer layer section, charge impregnation nature is raised more with the same field strength, and in order to pour in more amounts of charges, a charge impregnation nominal member may be used. the addition to each class of the organic multilayer section of this charge impregnation nominal member — desirable — 19 or less % of the weight of the weight of each class — especially — desirable — 0.05 - 9 % of the weight — it is . Here, explanation of the function of a charge impregnation nominal member etc. is as being indicated by the international applications PCT/JP 93/01198. Specifically, as for the electron-donative stilbene derivative, JISUCHIRIRU arylene derivative, or tris styryl arylene derivative used as a charge impregnation nominal member, the following compound is mentioned.
[0070]
[Formula 26]

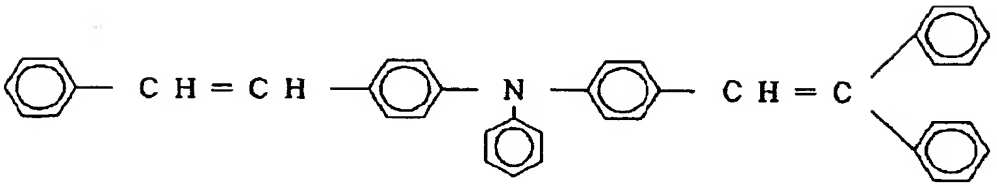


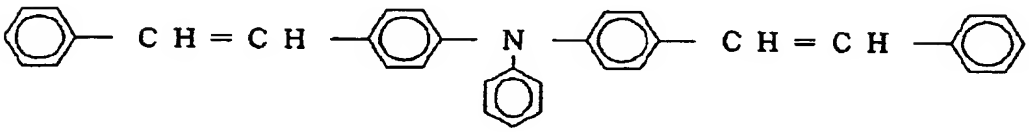




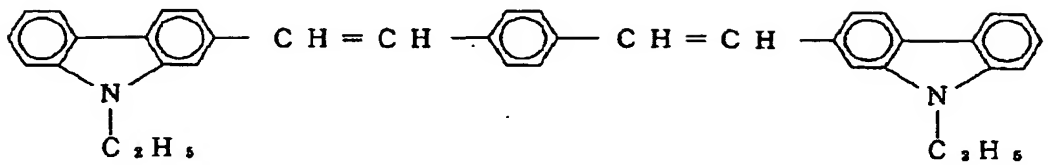


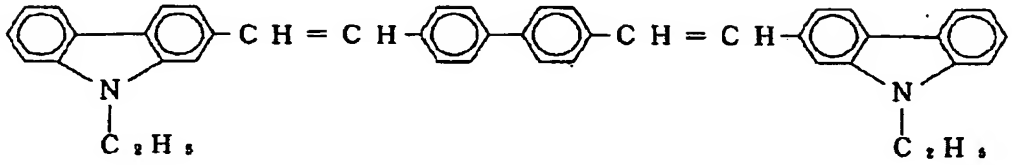


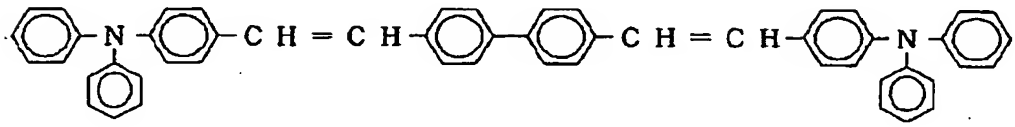


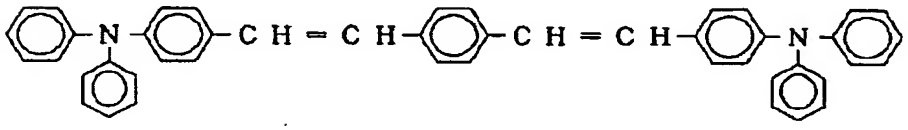


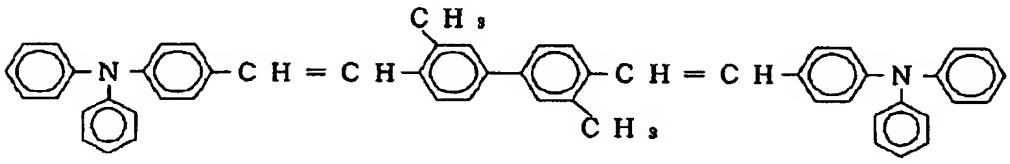
[0071]
[Formula 27]

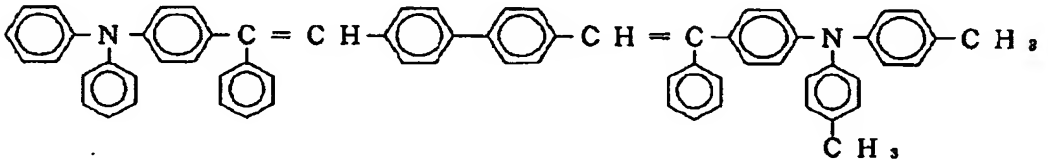


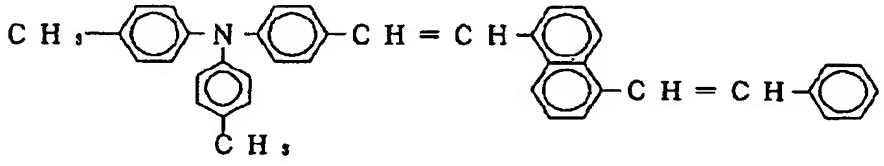




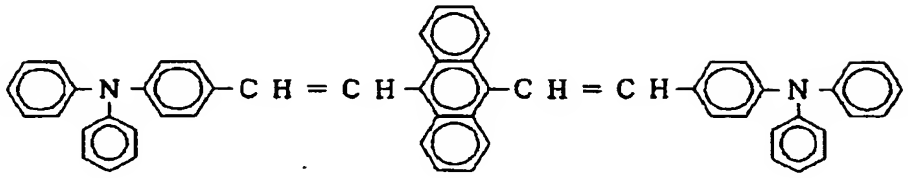


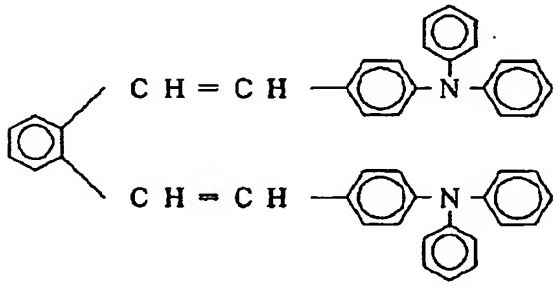


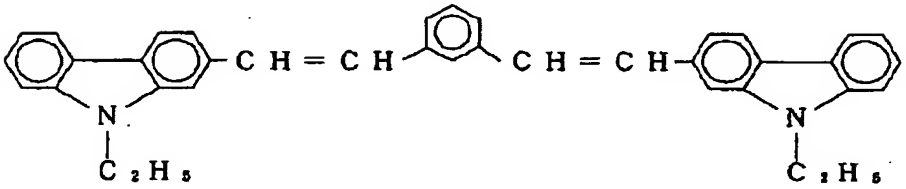


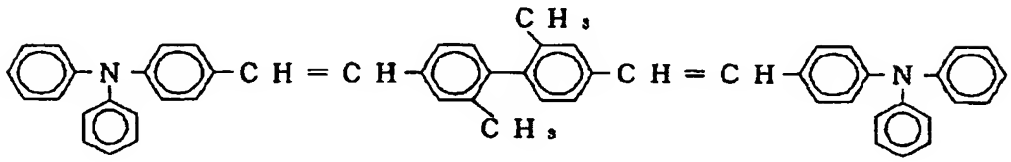


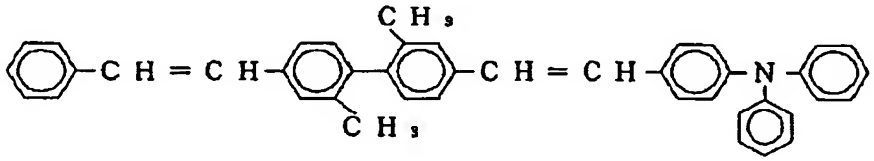
[0072]
[Formula 28]



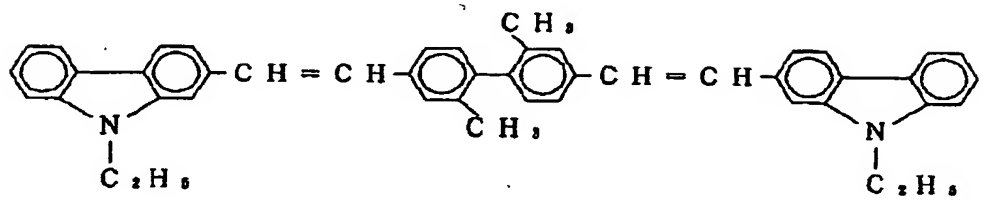


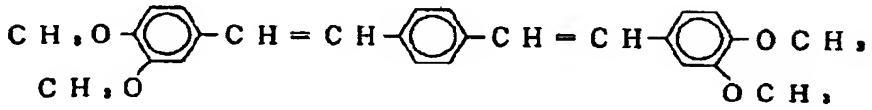


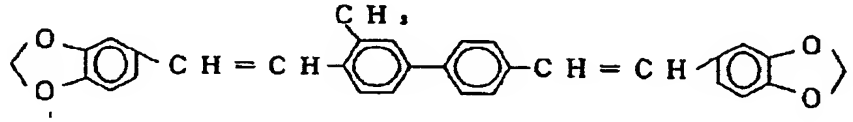


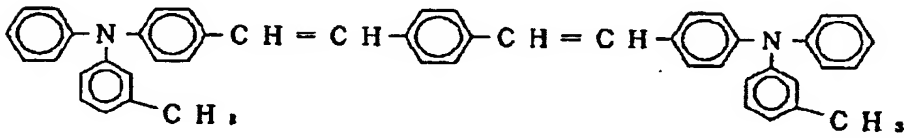


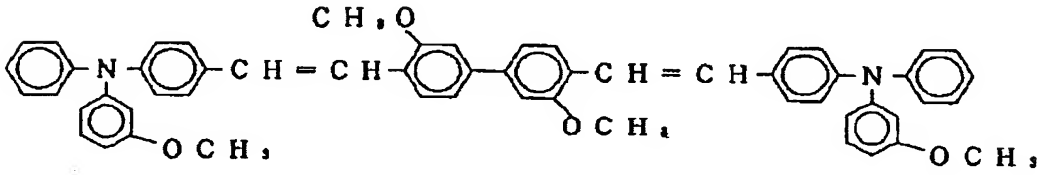
[0073]
[Formula 29]

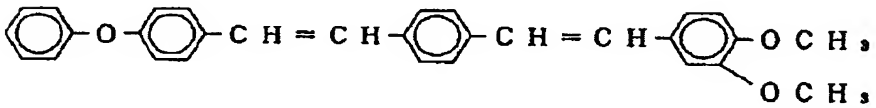


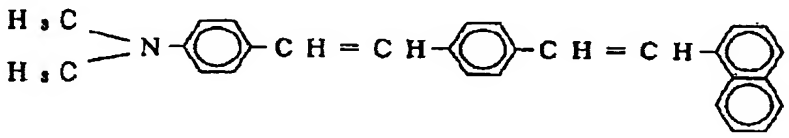




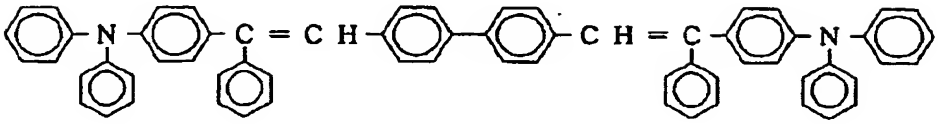


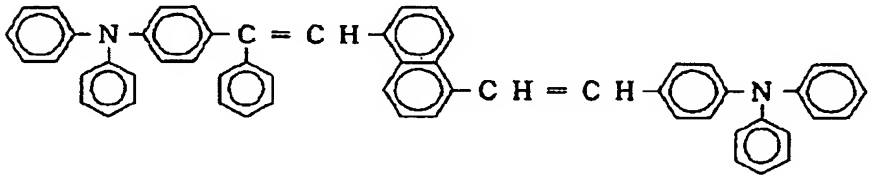


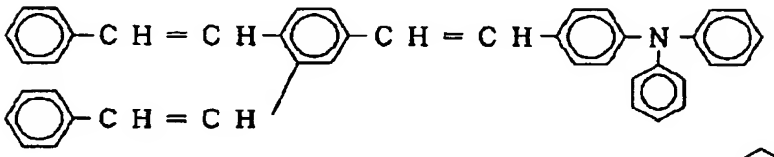


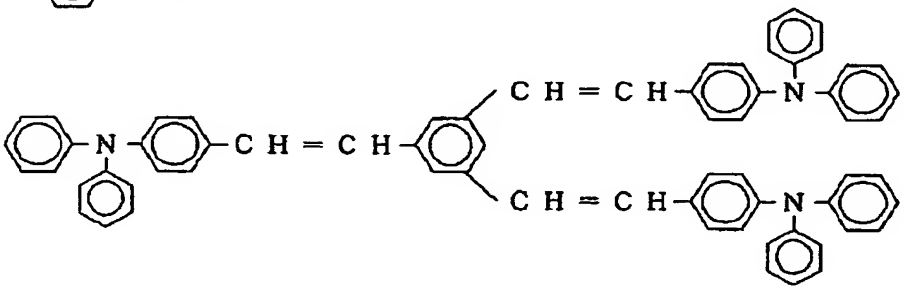


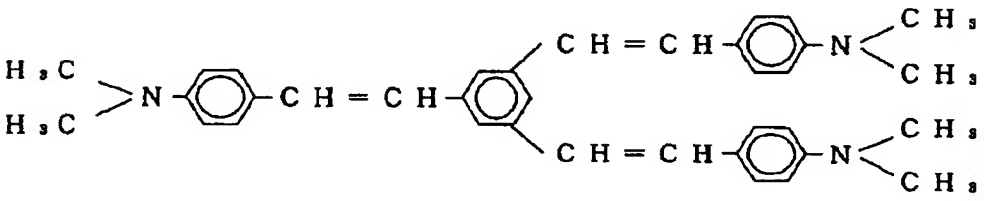
[0074]
[Formula 30]



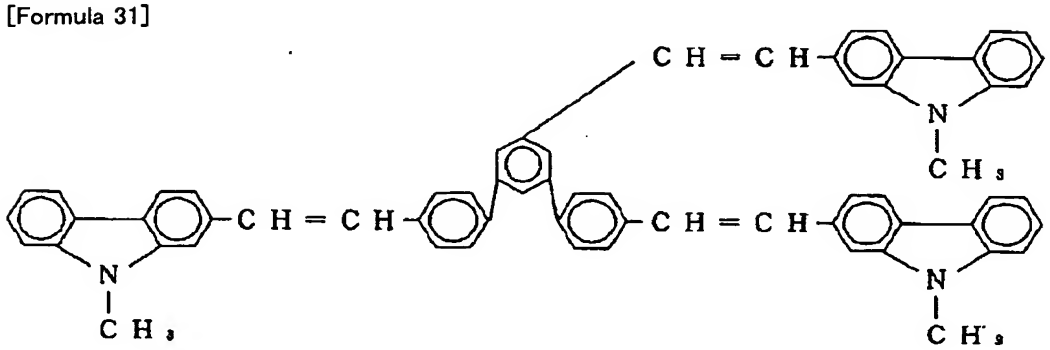


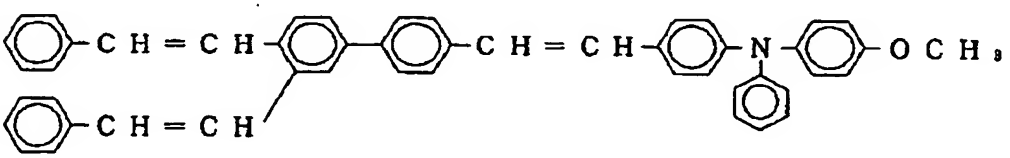


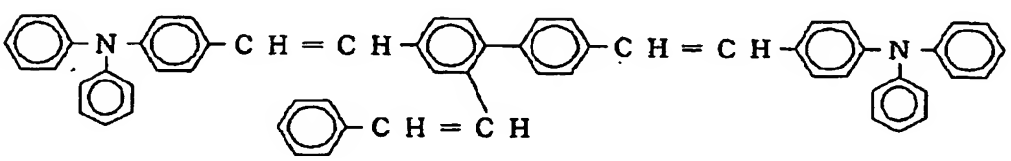




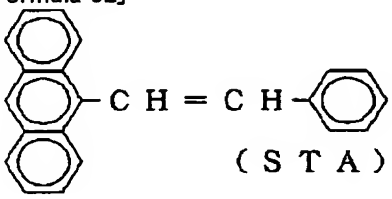
[0075]
[Formula 31]







[0076]
[Formula 32]



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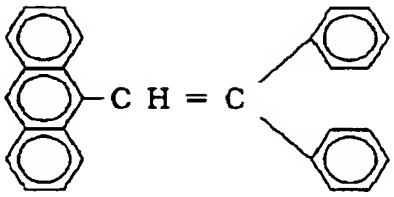

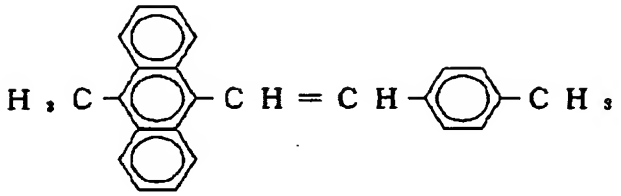

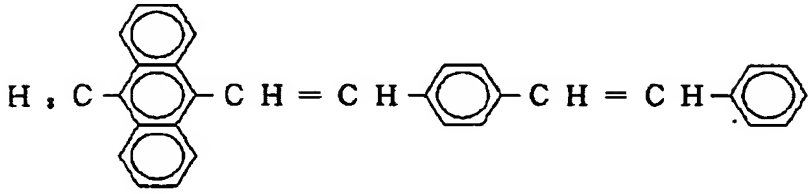

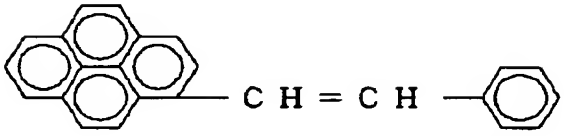

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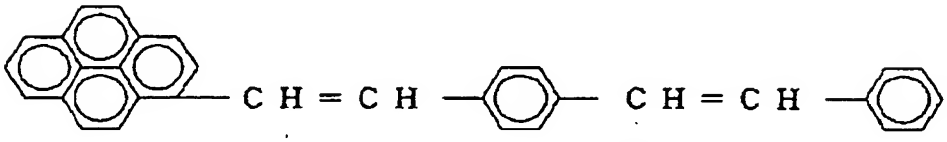
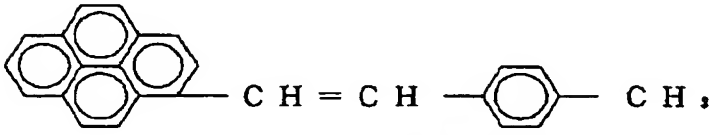
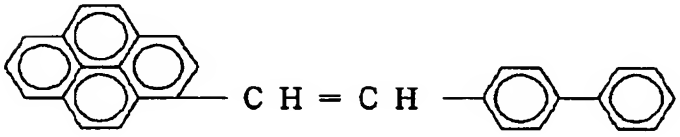


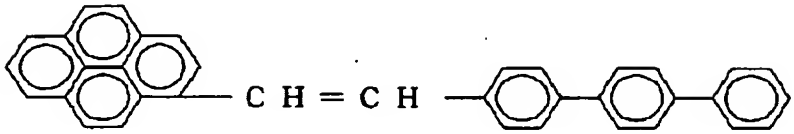
(STSTPy)

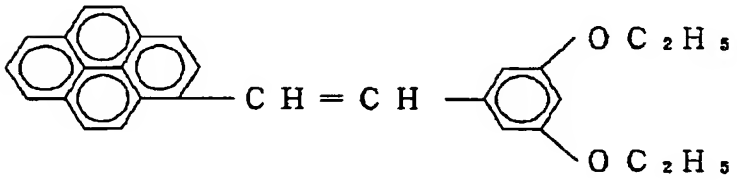


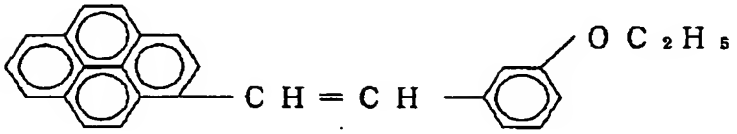
(MeSTPy)

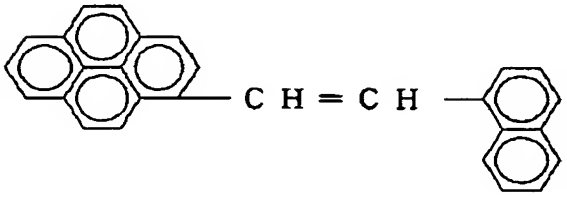


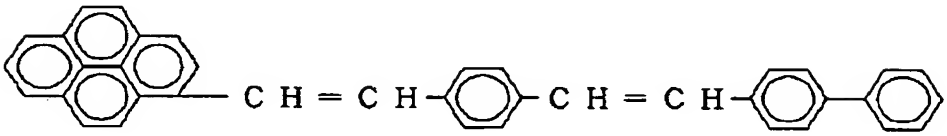
[0077]
[Formula 33]

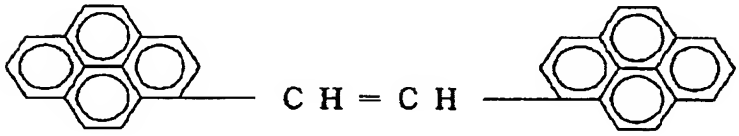


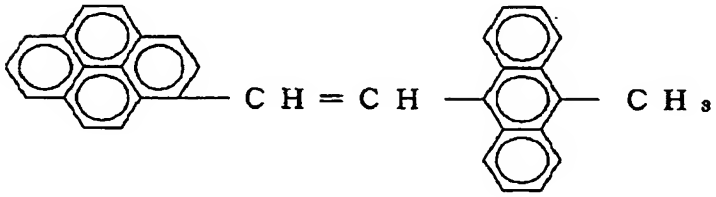




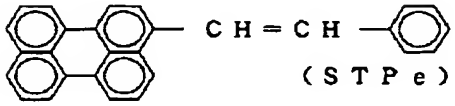


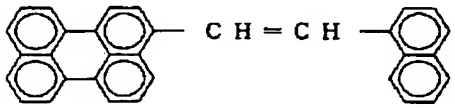


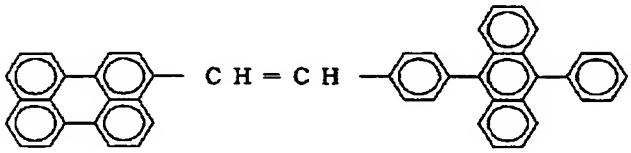


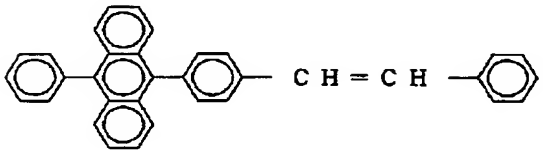


[0078]
[Formula 34]









[0079] Next, after making the matter for anode plates form by approaches, such as vacuum evaporationo and sputtering, so that it may become desired thickness and producing a transparent electrode (anode plate) on a suitable substrate, each thin film which consists of an electron hole transport ingredient, luminescent material, and an electron injection ingredient is made to form on this first, if the configuration of a substrate / transparent electrode / electron hole transportation zone layer / luminous layer / electronic injection layer / cathode is mentioned as an example and the suitable method of producing the EL element of this invention is explained. As the approach of this thin-film-izing, although there are a spin coat method, the cast method, vacuum deposition, etc., the point of the homogeneous film being easy to be obtained and being hard to generate a pinhole to a vacuum deposition method is desirable. When adopting this vacuum deposition as this thin film-ization, although it changes with crystal structures, meeting structures, etc. which are made into the class of compound to be used, and the object of the molecule deposition film, as for that vacuum evaporationo condition, it is desirable to choose suitably whenever [boat stoving temperature] generally in 50-450 degrees C, a 10-5 to ten to 8 Pa degree of vacuum, an evaporation rate 0.01 - 50 nm/sec, the substrate temperature of -50-300 degrees C, and the range of 5nm - 5 micrometers of thickness. Next, a desired EL element is obtained by making 10-500nm of thin films which consist of matter for cathode on it form by approaches, such as vacuum evaporationo and sputtering, after formation of these layers, so that it may become the thickness of the range of 50-200nm preferably, and preparing cathode. Thus, if + is impressed for an anode plate and it impresses about electrical-potential-difference 5-40V for cathode as a polarity of - in impressing direct current voltage to the obtained EL element, high luminescence of color purity can be observed. Moreover, even if it impresses an electrical potential difference with the polarity of reverse, luminescence is not produced at all, without a current flowing. Furthermore, in impressing alternating voltage, only when an anode plate changes + and cathode changes into the condition of -, it emits light. In addition, the wave of the alternating current to impress is arbitrary and good.

[0080]

[Example] Furthermore, although an example explains this invention to a detail, this invention is not limited at all by these examples.

What produced ITO by the thickness of anm with vacuum deposition on examples 1-3, and 25mm x75mmx the 1.1mm glass substrate [the product made from Japanese Sheet glass and OA-2] of production of the example 1-3 (1) EL element of a comparison [JIOMA tick company make] was used as the transparence support substrate. In addition, in isopropyl alcohol, after ultrasonic cleaning and nitrogen are sprayed, it dries for 5 minutes, and this substrate performs UV ozone washing [UV300 and SAMUKO international company make] for 10 minutes. This transparence support substrate is fixed to the substrate electrode holder of commercial vacuum evaporationo equipment [the product made from Japanese Vacuum technology]. N, N'-bis(3-methylphenyl)-N, N'-diphenyl (1 and 1'-biphenyl) -4, and 200mg (TPD) of 4'-diamines are put into the resistance heating boat made from molybdenum. The compound which 200mg (DPVBi) of 4 and 4'-bis(2 and 2'-diphenyl vinyl) biphenyls is put into other resistance heating boats made from molybdenum, and is a charge impregnation nominal member at the resistance heating boat made from molybdenum of further others (A) (it is shown in the 1st table.) 200mg was put in and the vacuum tub was decompressed up to 1x10 to 4 Pa. Said boat into which TPD went after that was heated to 215-220 degrees C, it vapor-deposited on the transparence support substrate with the evaporation rate of 0.1-0.3nm/second, and the hole injection layer of Thickness bnm was made to produce. At this time, the temperature of a substrate was a room temperature. It carried out the cnm laminating to the hole injection layer, having used DPVBi as the host ingredient, without taking this out from a vacuum tub. At this time, the boat of a compound (A) was heated to coincidence, and

the compound (A) was mixed to the luminous layer. the evaporation rate at this time — the evaporation rate [(B) shown in the 1st table] of DPVBi — receiving — the evaporation rate of (A) — (C) — (— it is shown in the 1st table.) — ** — it carried out. Then, the vacuum tub was returned to the atmospheric pressure, the 8-hydroxyquinoline aluminum complex (Alq) which is the ingredient of a glue line was newly put into the resistance heating boat made from molybdenum, magnesium ribbon 1g was further put into the resistance heating boat made from molybdenum, 500mg of silver wires was put into the basket made from a tungsten, and the vacuum tub was decompressed up to 1x10 to 4 Pa. Subsequently, the 8-hydroxyquinoline aluminum complex (Alq) was vapor-deposited with the evaporation rate of 0.01-0.03nm/second, and dnm formation of the glue line was carried out. Furthermore, silver was carried out with the evaporation rate of 0.1nm/second, the simultaneous vacuum evaporationo of the magnesium was carried out with the evaporation rate of 1.4nm/second, and the silver:magnesium mixing electrode was used as cathode. Thickness was 150nm. In addition, the reflection factor of cathode was 85%. The thickness of each class is shown in the 2nd table. moreover — each class — a refractive index — separate — the — vacuum evaporationo — the film — receiving — an ellipsomter — having measured — a place — ITO — TPD — DPVBi (doped layer) — and — Alq — a layer — a refractive index — respectively — one . — 86 — one . — seven — 1.75 — and — 1.7 — it is — this — a value — being based — the above — a component — (— nd —) — one — (— nd —) — two — [— (— nd —) — one — + — (— nd —) — two —] — having asked — . These results are shown in the 3rd table with lambda and m.

[0081]

[A table 1]

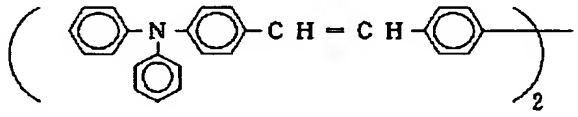
第 1 表

	(A)	(B) (nm/秒)	(C) (nm/秒)
実施例1	PAVBi	2.8～3.5	0.075
実施例2	PAVB	3.2～3.4	0.10
実施例3	PAVTP	2.7～3.5	0.13
比較例1	PAVBi	2.5～3.0	0.09
比較例2	PAVB	3.0～4.0	0.09
比較例3	PAVTP	2.7～3.5	0.13

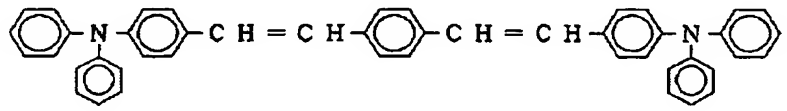
[0082]

[Formula 35]

PAVBi :



PAVB :



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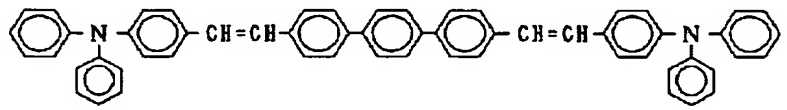

[0083]

[A table 2]

第 2 表

	各層の膜厚（ｎｍ）			
	a	b	c	d
実施例１	１２０	８０	４０	２０
実施例２	１２０	８０	４０	２０
実施例３	１００	１１０	４０	２０
比較例１	１００	６０	４０	２０
比較例２	１００	６０	４０	２０
比較例３	１００	８０	４０	２０

[0084]
[A table 3]

第 3 表－１

	光学膜厚		
	有機多層部 $(nd)_1$	透明電極 $(nd)_2$	$[(nd)_1+(nd)_2]$
実施例１	80 ×1.7 +40×1.75 +20×1.7	120 ×1.86	４６３
実施例２	80 ×1.7 +40×1.75 +20×1.7	120 ×1.86	４６３
実施例３	110 ×1.7 +40×1.75 +20×1.7	100 ×1.86	４７７
比較例１	60 ×1.7 +40×1.75 +20×1.7	100 ×1.86	３９２
比較例２	60 ×1.7 +40×1.75 +20×1.7	100 ×1.86	３９２
比較例３	80 ×1.7 +40×1.75 +20×1.7	100 ×1.86	４２６

[0085]
[A table 4]

第 3 表－２

	λ（ｎｍ）	m
実施例１	４６３	2
実施例２	４６３	2
実施例３	４７７	2
比較例１	３９２	2
比較例２	３９２	2
比較例３	４２６	2

[0086] Although lambda is filling the formula of 4 pi/lambda [(nd)1+(nd)2] =2mpi (m= 2) with examples 1-3 to blue

wavelength, in the examples 1-3 of a comparison, lambda has shifted from blue wavelength (blue wavelength: lambda= 440-490nm).
(2) The electrical potential difference shown in the 4th table was impressed to the component obtained by the measurement above (1) of the brightness of a component, and a chromaticity, and it asked for the amount of currents, brightness, and a chromaticity. The result is shown in the 4th table.
[0087]
[A table 5]

第 4 表

	電 圧 (V)	電流量 (mA/cm²)	輝 度 (cd/m²)	色 度
実施例 1	8	5.14	215	(0.159, 0.192)
実施例 2	8	3.0	194	(0.180, 0.275)
実施例 3	8	3.38	102	(0.173, 0.181)
比較例 1	6	6.9	119	(0.157, 0.242)
比較例 2	8	2.58	160	(0.179, 0.326)
比較例 3	8	6.67	253	(0.181, 0.215)

[0088] Compared with the thing of the example of a comparison, as for the thing of an example, the y-coordinate (chromaticity) is small so that an example 1, the example 1 of a comparison and an example 2, corresponding example 2 of a comparison and example 3, and the corresponding example 3 of a comparison may be compared and may be known. Since the optical thickness specified in the example is main blue wavelength (lambda), this satisfies the formula of 4 pi/lambda [(nd)1+(nd)2] =2mpi (m= 2), and shows that blue purity is high.
(3) EL spectrum of the component obtained in EL spectrum example 1 and the example 1 of a comparison of a component was measured. The result is shown in drawing 2 . In the example 1, it turns out that a 460nm peak is reinforced and it is large clearly from drawing 2 . Thereby, it was shown by the configuration of the component of this invention that blue purity is high.
[0089] The EL element as the thickness of each class shows in the 5th table was produced like the production example 1 of an examples 4-6 (1) EL element. However, in the example 4, ITO of the high refractive index 1.92 was used instead of ITO used in the example 1. Moreover, TiO2 of the refractive index 2.4 which is a high refractility substrate layer between a substrate and the ITO film in the example 5 The layer was prepared by 48nm of thickness with the vacuum deposition method. Furthermore, MgF2 of the refractive index 1.38 which is a low refractility substrate layer between a substrate and the ITO film in the example 6 The layer was prepared by 80nm of thickness with the vacuum deposition method. The thickness of each class is shown in the 5th table, and optical thickness, and lambda and m are shown in the 6th table.
[0090]
[A table 6]

第 5 表

	各 層 の 膜 厚 (nm)					
	a	b	c	d	TiO_2層	MgF_2層
実施例 4	116	80	40	20	−	−
実施例 5	60	80	40	20	48	−
実施例 6	120	80	40	20	−	80

[0091]
[A table 7]

第 6 表－1

	光学膜厚			
	有機多層部 $(nd)_1$	透明電極 $(nd)_2$ 又は $(nd)_3$	TiO_2層 $(nd)_4$	$[(nd)_1+(nd)_2]$ 又は $[(nd)_1+(nd)_3]$
実施例4	80×1.7 +40×1.75 +20×1.7	116×1.92	－	463
実施例5	80×1.7 +40×1.75 +20×1.7	60×1.86	48× 2.4	351
実施例6	80×1.7 +40×1.75 +20×1.7	120×1.86	－	463

[0092]
[A table 8]
第 6 表－2

	λ (nm)	m
実施例4	463	2
実施例5	470	2
実施例6	463	2

[0093] In the example 5, since the echo by the interface of a high refractility substrate layer and a transparent electrode arises, optical thickness is [(nd)1+(nd)3], and by the interface, since pi change of a phase is done, it serves as the case where 4 pi/lambda [(nd)1+(nd)3] =(2m−1) pi (m= 2) is satisfied. as mentioned above, 4 pi/lambda x[(nd)1+(nd)3+(nd)4] =2mpi (m= 2) — and — The example 5 is filling 4 pi/lambda x[(nd)1+(nd)3] =(2m−1) pi (m= 2) (here, it is lambda= 466nm). Therefore, it is shown by especially the example 5 that blue purity is increasing.
(2) The electrical potential difference shown in the 7th table was impressed to the component obtained by the measurement above (1) of the brightness of a component, and a chromaticity, and it asked for the amount of currents, brightness, and a chromaticity. The result is shown in the 7th table.
[0094]
[A table 9]

第 7 表

	電圧 (V)	電流量 (mA/cm^2)	輝度 (cd/m^2)	色度
実施例4	8	5	200	(0.159, 0.170)
実施例5	8	4.5	170	(0.151, 0.134)
実施例6	8	4.6	210	(0.158, 0.175)

[0095] As for examples 4–6, compared with the example 1 of a comparison, blue purity is all high. In addition, EL efficiency of element of this invention is mostly changeless, or is superior to the result of examples 1–6 rather. This shows the predominance of a remarkable technique with the configuration using a light filter to effectiveness being set to 1 / 2 - 1/3 in order to raise color purity. Furthermore, the EL element of the configuration of this invention is very simple, and easy to produce.
[0096]
[Effect of the Invention] According to this invention, in the component of a specific configuration, the organic EL device which raised especially the color purity of blue luminescence can be easily obtained by controlling the optical thickness from an anode plate to cathode. The organic EL device of such this invention is suitably used as for example, the display for information, or a numeric character display device.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application] About an organic electroluminescent element (it is hereafter written as an organic EL device.), in more detail, in the component of a specific configuration, this invention controls the optical thickness from an anode plate to cathode, and relates to the organic EL device which raised especially the color purity of blue luminescence.

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PRIOR ART

[Description of the Prior Art] Generally, since its visibility is high since an EL element is self-luminous, and it is a perfect solid-state component and handling is easy while excelling in shock resistance, the utilization as a light emitting device in various displays attracts attention. Since there are an inorganic EL element which used the inorganic compound for luminescent material, and an organic EL device using an organic compound in an EL element, among these an organic EL device can make applied voltage low substantially, the utilization research is made positively. About the configuration of the above-mentioned organic EL device, the thing of configurations, such as what prepared suitably the hole-injection transporting bed and the electron injection transporting bed in this on the basis of the configuration of an anode plate / luminous layer / cathode, for example, an anode plate / hole-injection transporting bed / luminous layer / cathode, and an anode plate / hole-injection transporting bed / luminous layer / electron injection transporting bed / cathode, is known. This hole-injection transporting bed has the function to transmit the electron hole poured in from the anode plate to a luminous layer, and the electron injection transporting bed has the function to transmit the electron poured in from cathode to a luminous layer. And it is known that the electron which many electron holes were poured into the luminous layer by lower electric field, and was further poured into the luminous layer from cathode or an electron injection transporting bed by making this hole-injection transporting bed intervene between a luminous layer and an anode plate will be accumulated in the interface of a hole-injection transporting bed and a luminous layer, and luminous efficiency will go up it since a hole-injection transporting bed does not convey an electron.

[0003] In such an organic EL device, each thickness of the thickness of each class in the organic multilayer section which intervenes between an anode plate and cathode, for example, a hole-injection transporting bed, a luminous layer, and an electronic injection layer is controlled, and many attempts which obtain the maximum effectiveness and the maximum, highest brightness are made. For example, in the configuration of an anode plate / electron hole transportability luminous layer / electronic transporting bed / cathode, the thickness of an electronic transporting bed is controlled to 30-60nm, and the technique which aimed at improvement in luminous efficiency is indicated (JP,4-137485,A). This shows that the distance between a luminous layer and cathode is an important factor. Moreover, the thickness of an electronic transporting bed is controlled, and in case the light produced from a luminous layer and the light reflected from cathode interfere, the technique reinforced substantially is indicated (JP,4-328295,A).

[0004] However, in these techniques, it is not shown at all by by selecting the optical thickness of the layer containing the organic multilayer section inserted by two reflexibility interfaces that the color purity of a component is improvable. Furthermore, although it was required with these techniques to control the thickness of an electronic transporting bed, the electronic injection layer participated in luminescence in this case, color purity deteriorated, or the situation of effectiveness falling which is not desirable was invited, and that improvement was called for. Moreover, the EL element of a configuration of having inserted the metallic oxide between an anode plate and cathode is indicated (JP,4-334895,A). However, in this technique, the metal oxide layer is prepared in order to intercept the ultraviolet rays which bring about degradation of an organic layer, and the technique of this invention is not suggested. Furthermore, it is the configuration of an anode plate / hole injection layer / luminous layer / electronic injection layer / cathode, and the EL element using the mixing layer of a specific metal complex and organic compounds other than this is proposed as this electronic injection layer (Japanese Patent Application No. No. 96407 [five to]). However, in this technique, it has not set up so that the reinforcement in the wavelength from which EL light which generates the optical thickness of the organic multilayer section was selected may be reinforced, and this is not shown at all. Moreover, in the component which consists of a substrate / dielectric multilayer / transparent electrode / the organic multilayer section / cathode, the technique of raising color purity is known by controlling the sum total optical thickness of a transparent electrode and the organic multilayer section. However, it is necessary to use a dielectric multilayer and does not escape becoming cost high in this technique.

[0005] On the other hand, in the configuration of a transparent electrode / dielectric layer / fluorescent substance layer / dielectric layer / back plate, the technique with which it was made for the thickness (d) and the refractive index of the laminating structure of a fluorescent substance layer or a fluorescent substance layer, and a dielectric layer (eta) to fill the relational expression of d=k-eta-lambda/2 (here, lambda is luminescence wavelength.) is indicated (JP,2-46695,A). The insulator layer to which inorganic fluorescent substances, such as ZnS, become a dielectric layer from an oxide etc. again is used for this fluorescent substance layer, and he is trying to interfere in the light emitted from a fluorescent substance layer in between the interface of a transparent electrode and a dielectric layer, and the interfaces of a dielectric layer and a back plate by setting up the thickness of the laminating

structure of a fluorescent substance layer or a fluorescent substance layer, and a dielectric layer according to that refractive index after a multiple echo in this technique. However, with this configuration, since the refractive index of a transparent electrode is about [1.8 or less] while it is 2.0 or more, the refractive index of a dielectric layer or a fluorescent substance layer deals with the interface of this transparent electrode and a dielectric layer as reflexibility. On the other hand, in the configuration of the transparent electrode / organic multilayer section / cathode currently indicated by this invention, the refractive indexes of the organic multilayer section are 1.6-1.8, and it cannot be said that the interface of a transparent electrode and the organic multilayer section is reflexibility. Above-mentioned JP,2-46695,A does not show the interface of a transparent electrode and a substrate, the interface of a transparent electrode and a high refractility substrate layer, or the interface of a transparent electrode and a low refractility substrate layer at all like this invention about controlling the sum total optical thickness of handling and a transparent electrode, and the organic multilayer section as reflexibility.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, in the component of a specific configuration, the organic EL device which raised especially the color purity of blue luminescence can be easily obtained by controlling the optical thickness from an anode plate to cathode. The organic EL device of such this invention is suitably used as for example, the display for information, or a numeric character display device.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] This invention is the basis of such a situation, in the component of a specific configuration, controls the optical thickness from an anode plate to cathode, and is made for the purpose of offering the organic EL device which raised especially the color purity of blue luminescence.

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MEANS

[Means for Solving the Problem] this invention persons control optical thickness, and as a result of repeating research wholeheartedly that the organic EL device which raised the color purity of blue luminescence should be developed, they set in the configuration of (1) substrate / high refractility transparent electrode / organic multilayer section / cathode. The sum total optical thickness of this high refractility transparent electrode and the organic multilayer section is set in the configuration of (2) substrates / high refractility substrate layer / transparent electrode / organic multilayer section / cathode. The sum total optical thickness of this high refractility substrate layer, a transparent electrode, and the organic multilayer section Or the sum total optical thickness of a transparent electrode and the organic multilayer section is set in the configuration of (3) substrates / low refractility substrate layer / transparent electrode / organic multilayer section / cathode. It found out that the object could be attained by setting up the sum total optical thickness of this transparent electrode and the organic multilayer section so that the reinforcement in the wavelength from which EL light which emits light from the organic multilayer section with a specific refractive index was selected may be reinforced. This invention is completed based on this knowledge.
[0008] Namely, this invention is an organic EL device which consists of (1) substrate / high refractility transparent electrode / the organic multilayer section / cathode. Wavelength lambda of EL light which the sum total optical thickness of a high refractility transparent electrode and the organic multilayer section generates from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is chosen from 440-490nm, 500-550nm, and 600-650nm.) The organic EL device characterized by being set up so that the reinforcement which can be set may be reinforced [1], (2) Wavelength lambda of EL light which is the organic EL device which consists of a substrate / high refractility substrate layer / transparent electrode / the organic multilayer section / cathode, and the sum total optical thickness of a high refractility substrate layer, a transparent electrode, and the organic multilayer section generates from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is the same as the above.) The organic EL device characterized by being set up so that the reinforcement which can be set may be reinforced [2], (3) Wavelength lambda of EL light which is the organic EL device which consists of a substrate / high refractility substrate layer / transparent electrode / the organic multilayer section / cathode, and the sum total optical thickness of a transparent electrode and the organic multilayer section generates from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is the same as the above.) It is the organic EL device which consists of the organic EL device [3] characterized by being set up so that the reinforcement which can be set may be reinforced and (4) substrates / low refractility substrate layer / transparent electrode / the organic multilayer section / cathode. Wavelength lambda of EL light which the sum total optical thickness of a transparent electrode and the organic multilayer section generates from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is the same as the above.) The organic EL device [4] characterized by being set up so that the reinforcement which can be set may be reinforced is offered.
[0009] The organic EL device [1] of this invention consists of a substrate / a high refractility transparent electrode / the organic multilayer section / cathode. Although what has transparency, for example, glass, a quartz, an organic high molecular compound, etc. are mentioned as this substrate, in these, a with a refractive index of 1.6 or less thing is suitable. Moreover, as for a high refractility transparent electrode, what has the highest possible refractive index so that the echo of light may take place by the interface of a with an above-mentioned refractive index of 1.6 or less low refractility substrate and this transparent electrode is desirable, and a desirable refractive index is 1.9 or more especially preferably 1.8 or more. As such a high refractility transparent electrode, what a refractive index chooses 1.9 or more things suitably preferably, and uses as electrode material 1.8 or more is preferably used out of the dielectric large (4eV or more) transparent material, ITO, ZnO, and SnO2, of a work function, CuI, etc. [for example,] By approaches, such as vacuum evaporationo and sputtering, by making a thin film form on a substrate, the above-mentioned electrode material is produced and this high refractility transparent electrode can carry out the thing of it. When taking out luminescence from this electrode, it is desirable to make permeability larger than 10%, and below hundreds of ohms / ** of the sheet resistance as an electrode are desirable. Furthermore, as the organic multilayer section, well-known various things can be conventionally used so that it may mention later. On the other hand, cathode is the film of mirror plane nature and what reflects more preferably EL light generated from the organic multilayer section 70% or more 50% or more is suitable for it. As such cathode, it chooses suitably from the small (4eV or less) metal of a work function, an alloy, electrical conductivity compounds, and such mixture, and what is used as electrode material is used. As an example of such electrode material, a sodium and sodium-potassium alloy, magnesium, a lithium, a magnesium-silver alloy, aluminum/aluminum 2O3, an indium, a rare earth metal, etc. are mentioned. By approaches, such as vacuum evaporationo and sputtering, this

cathode can produce such electrode material by making a thin film form. Moreover, below hundreds of ohms / ** of the sheet resistance as an electrode are desirable, and especially thickness usually has the desirable range of 50-200nm 10nm - 1 micrometer.

[0010] In the organic EL device [1] of this invention, it is required to set up the sum total optical thickness of the above-mentioned high refractility transparent electrode and the organic multilayer section so that the reinforcement in the main wavelength lambda of EL light generated from the organic multilayer section of refractive indexes 1.6-1.8 may be reinforced. Here, when lambda desires blue luminescence, 440-490nm is chosen, and in the case of 500-550nm and red, it is chosen from 600-650nm when green. That is, generally it is the optical thickness of 1 and a high refractility transparent electrode about the optical thickness of the organic multilayer section 2 When it carries out, such sum total optical thickness [(nd)1+(nd)2] is formulas. 4 pi/lambda [(nd)1+(nd)2] =2mpi ... (I)
or — 4 pi/lambda [(nd)1+(nd)2] =(2m-1) pi .. (II)
It is set up so that ****** may be filled. In the above-mentioned formula (I) and (II), a refractive index and d are thickness and the integer of 1-10 and n of m of lambda are the same as that of the above. This type (I) and (II) are chosen with the refractive index of a cathode metal. for example, — < (refractive index of the organic multilayer section) (refractive index of a cathode metal) — in the case of the reverse, a formula (I) is chosen for a formula (II), but a case is not necessarily good to examine by producing actually and to adjust a component, when the refractive index of a cathode metal does not become clear from the start. In addition, it can ask for the optical thickness of each class by the product of the thickness of the layer, and a refractive index. When the sum total optical thickness of a high refractility transparent electrode and the organic multilayer section is set up so that the above-mentioned conditions may be fulfilled, the main wavelength is reinforced and EL light which comes out from a component does so the remarkable effectiveness that color purity improves. When this effectiveness is excellent, the color of an organic EL device becomes clear, and also when realizing any of R, G, and B for being full color, it can use.

[0011] Next, the organic EL device [2] of this invention and [3] consist of a substrate / high refractility substrate layer / a transparent electrode / the organic multilayer section / cathode. The thing same as this substrate, the organic multilayer section, and cathode as what was explained with said organic EL device [1] can be used. moreover, the parenchyma top in which a high refractility substrate layer has a with a refractive indexes of 1.8 or more high refractive index — a transparent layer — it is — desirable — a refractive index — 2.0 or more oxide layers 2, for example, TiO, ZrO2, ZnO, SiO and Sc 2O3, HfO2, and CeO2 etc. — it is the layer which is known conventionally and which consists of a transparent dielectric optically. Furthermore, the layer which consists of ZnS, ZnSSe, ZnTe, GaN, InGaN, AlN, BeN, etc. is also suitable. Although what, on the other hand, uses as electrode material the dielectric transparent material illustrated as a transparent electrode in explanation of the high refractility transparent electrode of said organic EL device [1] can be used, as for the refractive index, it is advantageous that it is 1.8 or more.

[0012] It is the case where the echo of light arises in the interface of a substrate and a high refractility substrate layer in the organic EL device [2] of this invention. Therefore, main wavelength lambda of EL light which generates the sum total optical thickness of a high refractility substrate layer, a transparent electrode, and the organic multilayer section from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is the same as the above.) It is required to set up so that the reinforcement which can be set may be reinforced. That is, generally it is the optical thickness of 3 and a high refractility substrate layer about 1 and the optical thickness of a transparent electrode in the optical thickness of the organic multilayer section 4 When it carries out, Such sum total optical thickness [(nd)1+(nd)3+(nd)4] formula 4 pi/lambda [(nd)1+(nd)3+(nd)4] =2mpi ... (III) — or — 4 pi/lambda [(nd)1+(nd)3+(nd)4] =(2m-1) pi ... (IV) [— however, lambda, m, n, and d are the same as the above.] It is set up so that ****** may be filled. The above-mentioned formula (III) and (IV) It is chosen with the refractive index of a cathode metal like the case of an organic EL device [1].

[0013] On the other hand in an organic EL device [3], it is the case where the echo of light arises in the interface of a high refractility substrate layer and a transparent electrode, therefore it is required to set up the sum total optical thickness of a transparent electrode and the organic multilayer section so that the reinforcement in the main wavelength lambda of EL light generate from the organic multilayer section of refractive indexes 1.6-1.8 (it is here and lambda is the same as the above.) may be reinforce. That is, generally they are 1 and the optical thickness of a transparent electrode about the optical thickness of the organic multilayer section 3 When it carries out, such sum total optical thickness [(nd)1+(nd)3] is formulas. 4 pi/lambda [(nd)1+(nd)3] =2mpi ... (V)
or — 4 pi/lambda [(nd)1+(nd)3] =(2m-1) pi ... (VI) — [— however, lambda, m, n, and d are the same as the above.] It is set up so that ****** may be filled. The above-mentioned formula (V) and (VI) It is chosen with the refractive index of a cathode metal like the case of an organic EL device [1]. however — < (refractive index of the organic multilayer section) (metaled refractive index) — a case — a formula (V) — moreover, in the case of the reverse, a formula (VI) is chosen.

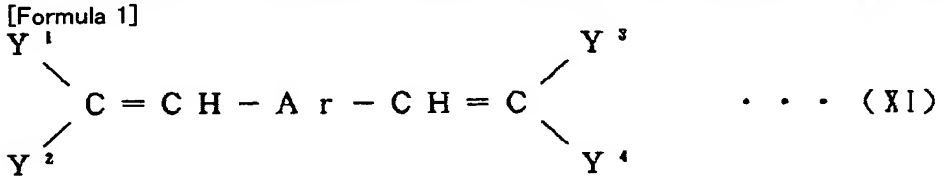
[0014] Moreover, an echo may arise in the interface of a high refractility substrate layer and a transparent electrode, and both the interfaces of the interface of a substrate and a high refractility substrate layer. For example, it is the refractive index of the refractive-index <refractive index of high refractility substrate layer> substrate of a transparent electrode, and is the case that each refractive-index difference is large. in such a case, optical thickness — formula 4 pi/lambda 1 [(nd)1+(nd)3] =(2m-1) pi .. (VII) 4 pi/lambda 2 [(nd)1+(nd)3+(nd)4] =2mpi .. (VIII) -- [— however, m, n, and d are the same as the above.] It sets up so that ****** may be filled. The above-mentioned formula (VII) (VIII), It sets and is lambda 1. And although it is chosen from 440-490nm in the case of 500-550nm and red when lambda 2 is blue and is chosen from 600-650nm when green, it does not necessarily need to be

in agreement. Moreover, formula (VII) (VIII), Like the case of said organic EL device [1], although it is the case of > (refractive index of the organic multilayer section) (refractive index of cathode), in the case of this reverse, it is a formula. 4 pi/lambda 1 [(nd)1+(nd)3] =2mpi ... (IX)
4 pi/lambda 2 [(nd)1+(nd)3+(nd)4] =(2m+1) pi ... (X)
It sets up so that ****** may be filled. Thus, above-mentioned formula (VII)/(VIII) Or when choosing formula (IX)/(X) carries out incidence of the high refractive-index side from a low refractive-index side, the phase of light is because variation is 0 in the case of the reverse pi change, although carried out. Naturally it is necessary to take change of this phase into consideration for setting out of the above-mentioned optical thickness. Especially, it is lambda1 =lambda2. Although it becomes lambda/4, in this case, it is large, and sometimes especially enhancement of the reinforcement in the main wavelength of EL light does not need to sandwich the organic multilayer section in the approach and (2) dielectric multilayer which improve color purity with the technique, for example, (nd) 4 =(1) light filter, of improving well-known color purity conventionally, and a cathode mirror plane, and does not need to use for it the approach of improving color purity etc. The organic EL device [2] of this invention and the configuration of [3] simpler than the configuration used by the above (1) and (2) are clear.
[0015] Furthermore, the organic EL device [4] of this invention consists of a substrate / low refractility substrate layer / a transparent electrode / the organic multilayer section / cathode. The thing same as this substrate, the organic multilayer section, and cathode as what was explained with said organic EL device [1] can be used.
Moreover, although what uses as electrode material the dielectric transparent material illustrated as a transparent electrode in explanation of the high refractility transparent electrode of said organic EL device [1] can be used, as for the refractive index, it is advantageous that it is 1.8 or more. Furthermore, although the thing of a low refractive index can be suitably chosen as a low refractility substrate layer and can be conventionally used for it out of a well-known dielectric material, a refractive index becomes 1.4 or less and is suitable for the layer which consists of metal fluorides, such as CaF2, MgF2, and LiF, for example. Moreover, the layer which consists of fluorine-containing polymers, such as fluorination acrylic resin and a Teflon system copolymer, is also desirable. In this organic EL device [4], the echo of light arises in the interface of a low refractility substrate layer and a transparent electrode. Therefore, it is required to set up the sum total optical thickness of a transparent electrode and the organic multilayer section so that the reinforcement in the main wavelength lambda of EL light generated from the organic multilayer section of refractive indexes 1.6-1.8 (here, lambda is the same as the above.) may be reinforced. That is, generally they are 1 and the optical thickness of a transparent electrode about the optical thickness of the organic multilayer section 3 When it carries out, those sum total optical thickness [(nd)1+(nd)3] is formulas. 4 pi/lambda [(nd)1+(nd)3] =2mpi ... (V)
or — 4 pi/lambda [(nd)1+(nd)3] =(2m-1) pi .. (VI) — [— however, lambda, m, n, and d are the same as the above.]
It is set up so that ****** may be filled. The above-mentioned formula (V) and (VI) It is chosen with the refractive index of a cathode metal like the case of an organic EL device [1].
[0016] Next, the principle of organic EL device [1]- [4] of this invention is explained. Combining mutually the electron poured in from cathode, and the electron hole poured in from the anode plate, the excitation state of the molecule which is luminescent material, or a polymer is made, and this excitation state gives off light and returns to a ground state. When emitted, after this light was reflected by the ** interface A when being emitted from the direction of the interface B which is ** transparence, as drawing 1 R> 1 shows, and being further reflected by the ** interface B and being continuously reflected by Interface A, when emitted, various bleedoff light exists. Actually, these interfere and the multiplex interference in the so-called Fabry-Perot interference arises. As a result of such interference, in the component which fulfills the conditions of the aforementioned optical thickness, it is emitted in the form where the light of wavelength lambda (it is here and lambda is the same as the above.) was reinforced, and color purity improves. Here, although Interface A is an interface of the cathode and the organic multilayer section which have a speculum side, Interface B has the following class by the configuration of a component.
In the case of a component [1], (1) In the interface of a substrate and a high refractility transparent electrode, the case of (2) components [2] In the case of the interface of a substrate and a high refractility substrate layer, and (3) components [3], the interface of a high refractility substrate layer and a transparent electrode, (4) In the case of a component [4], the larger one of the difference (difference of the refractive index between the layers which sandwich Interface B) of the interface of a low refractility substrate layer and a transparent electrode and the refractive index in this interface B is desirable, but the width of face which can be chosen on parenchyma is 0.2-1.5 preferably. In addition, this invention does not mean using the repeat multilayer configuration of a high refractive-index layer / low refractive-index layer for Interface B. Although it being complicated and producing to homogeneity brings about high wavelength selection a difficult top and it contributes to the improvement in color purity, such a configuration brings about the disadvantageous point that the main wavelength of EL light changes with angles of visibility rapidly simultaneously, therefore is hard to be used for a large area display device.
[0017] On the other hand, while having the property which should be observed in which the organic EL device of this invention has a small angle-of-visibility dependency, it also has the useful property in which color purity can be raised. this invention — an organic EL device — [— one —] - [— four —] — it can set — organic — a multilayer — the section — a configuration — ****** — for example — a transparent electrode — a side — from — cathode — a side — applying — (— one —) — an electron hole — a transportation zone — a layer — /— a luminous layer — (— two —) — an electron hole — a transportation zone — a layer — /— a luminous layer — /— an electronic injection layer — (— three —) — a luminous layer — /— an electronic injection layer — (— four —) — an organic semiconductor — a layer — /— a luminous layer — (— five —) — an organic semiconductor — a

layer — /— an electron — a barrier layer — /— a luminous layer — (— six —) — an electron hole — a transportation zone — a layer — /— a luminous layer — /— adhesion — an improvement — a layer — In these configurations, the configuration of an electron hole transportation zone layer / luminous layer, an electron hole transportation zone layer / luminous layer / electronic injection layer, and an electron hole transportation zone layer / luminous layer / adhesion improvement layer is suitable.

[0018] In this invention, it is advantageous in the organic multilayer section of such a configuration to reinforce the reinforcement in the main wavelength lambda of EL light generated from this organic multilayer section (for it to be here and for lambda to be the same as the above.) by selecting the thickness of an electron hole transportation zone layer or a luminous layer especially. In this invention, although the refractive indexes of each class in the above-mentioned organic multilayer section may differ, respectively, the value needs to be in the range of 1.6-1.8. In addition, since the echo by the interface of a transparent electrode and the organic multilayer section has the small refractive-index difference of this transparent electrode and the organic multilayer section, there is, therefore it does not use the echo by this interface by this invention. [little] As a luminous layer in the above-mentioned organic multilayer section, it is (a) impregnation function (at the time of electrical-potential-difference impression) like the usual luminous layer. an electron hole can be poured in from an anode plate or an electron hole transportation zone layer, and an electron can be poured in from cathode or an electronic injection layer. (b) transport function (it is possible to move an electron hole and an electron according to the force of electric field.) (c) luminescence function (it is possible to offer the field of recombination of an electron hole and an electron and to make it emit light.) It has. Although the thickness of this layer does not have especially a limit and it can determine according to a situation suitably, 1nm - 10 micrometers are 5nm - 5 micrometers especially preferably preferably. Here, as a desirable luminescent material (host ingredient), it is general formula (XI) [0019].

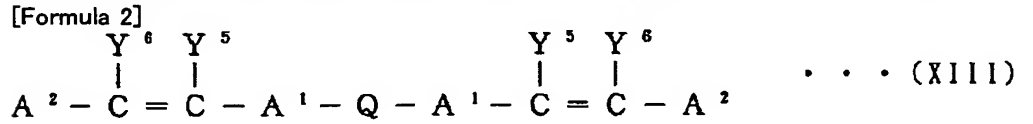
[Formula 1]



$$\begin{matrix} Y^1 & & & & Y^3 \\ \diagdown & & & & \diagup \\ & C=CH-Ar-CH=C & & & \\ \diagup & & & & \diagdown \\ Y^2 & & & & Y^4 \end{matrix} \quad \cdots (XI)$$

[0020] Y1 -Y4 shows among [type the aryloxy group of the carbon numbers 6-18 which are not permuted [the cyclohexyl radical which is not permuted / the aryl group of the carbon numbers 6-18 which are not permuted / a hydrogen atom, the alkyl group of carbon numbers 1-6, the alkoxy group of carbon numbers 1-6, the aralkyl radical of carbon numbers 7-8, a permutation, or /, a permutation, or /, a permutation, or], and the alkoxy group of carbon numbers 1-6, respectively. Here, a substituent shows the alkyl group of carbon numbers 1-6, the alkoxy group of carbon numbers 1-6, the aralkyl radical of carbon numbers 7-8, the aryloxy group of carbon numbers 6-18, the acyl group of carbon numbers 1-6, the acyloxy radical of carbon numbers 1-6, a carboxyl group, a styryl radical, the aryl carbonyl group of carbon numbers 6-20, the aryloxy carbonyl group of carbon numbers 6-20, the alkoxy carbonyl group of carbon numbers 1-6, a vinyl group, an ANIRINO carbonyl group, a carbamoyl group, a phenyl group, a nitro group, a hydroxyl group, or a halogen. These substituents may be single or plural is sufficient as them. Moreover, Y1 -Y4 Even if the same, you may differ mutually, and it is Y1. Y2 And Y3 Y4 It may combine with the radical permuted mutually and the saturation six membered ring which is not permuted [the saturation five membered ring which is not permuted / a permutation or /, a permutation, or] may be formed. Ar expresses the arylene radical of the carbon numbers 6-20 which are not permuted [a permutation or], and even if the single permutation is carried out, it carries out two or more permutations — having — **** — moreover, a binding site — alt., Para — meta—— any are sufficient. However, it is Y1 -Y4 when Ar is a non-permuted phenylene group. It is chosen out of the naphthyl group which is not permuted [the alkoxy group of carbon numbers 1-6, the aralkyl radical of carbon numbers 7-8, a permutation, or], a biphenyl radical, a cyclohexyl radical, and an aryloxy group, respectively.] General formula (XII) A-Q-B ... (XII) Among [type, A and B show the monad excluding one hydrogen atom from the compound expressed with the above-mentioned general formula (XI), respectively, may be the same, or may differ, and Q shows the bivalence radical which cuts conjugated system.] Or a general formula (XIII) [0021]

[Formula 2]

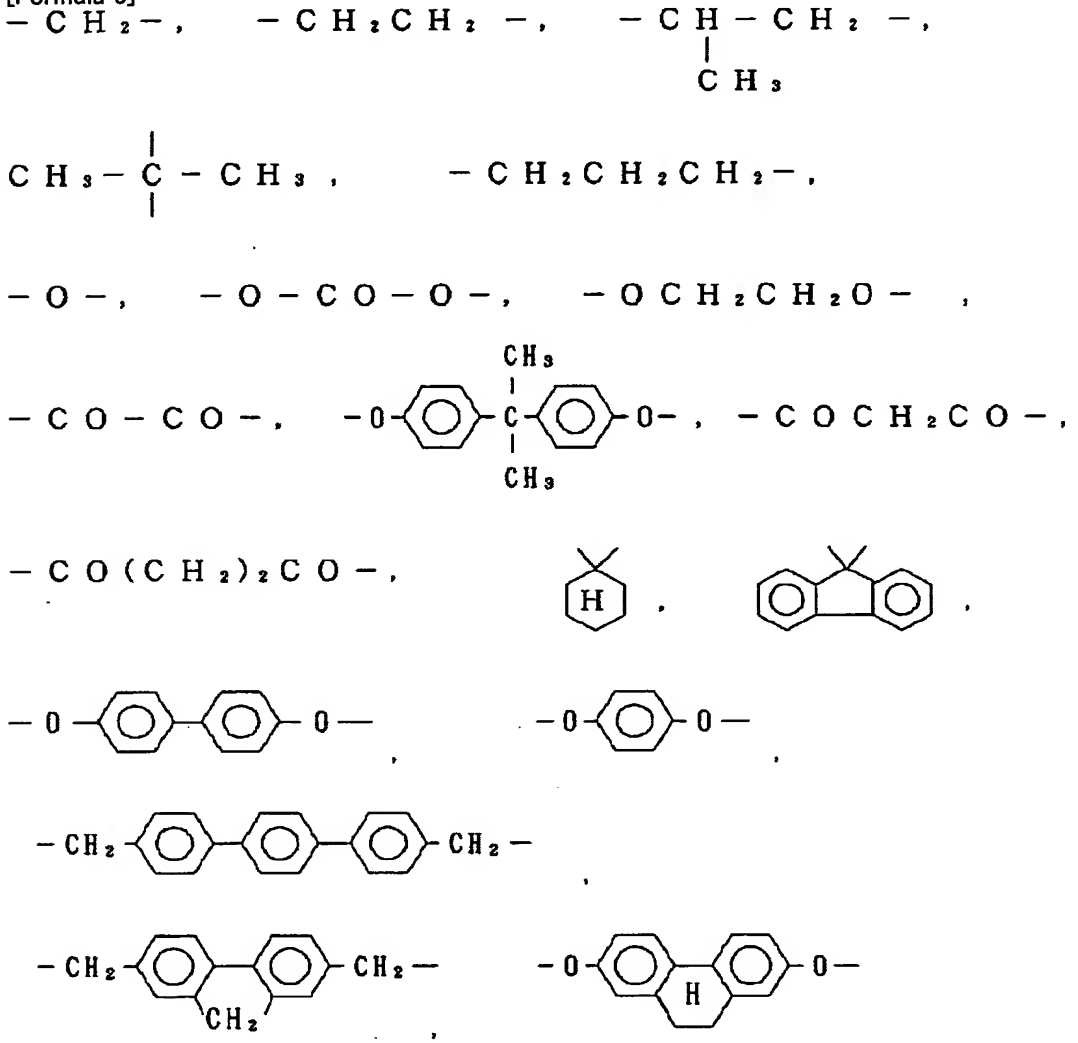


$$A^2-\underset{\displaystyle Y^6}{\underset{|}{C}}=\underset{\displaystyle Y^5}{\underset{|}{C}}-A^1-Q-A^1-\underset{\displaystyle Y^5}{\underset{|}{C}}=\underset{\displaystyle Y^6}{\underset{|}{C}}-A^2 \quad \cdots (XIII)$$

[0022] A1 shows among [type the arylene radical of the carbon numbers 6-20 which are not permuted [a permutation or], or the aromatic heterocycle type machine of bivalence. Any of alt., meta and Para are sufficient as a joint location. A2 The aryl group of the carbon numbers 6-20 which are not permuted [a permutation or] or the aromatic heterocycle type machine of monovalence is shown. Y5 And Y6 The aryl group of the carbon numbers 6-20 which are not permuted [a hydrogen atom, a permutation, or], a cyclohexyl radical, the aromatic heterocycle type machine of monovalence, the alkyl group of carbon numbers 1-10, the aralkyl radical of carbon numbers 7-20, or the alkoxy group of carbon numbers 1-10 is shown, respectively. In addition, Y5 and Y6 It may be the same or you may differ. Here, a substituent is a phenyl group which in the case of a single permutation it does not have or it has an alkyl group, an aryloxy group, an amino group, or a substituent. Y5 Each substituent is A1. It may join together, the five membered ring or six membered ring of saturation or partial saturation may be formed, and it is Y6

similarly. Each substituent is A2. It may join together and the five membered ring or six membered ring of saturation or partial saturation may be formed. Moreover, Q expresses the bivalence radical which cuts conjugate.] It comes out and the compound expressed is mentioned. In addition, although a general formula (XII) and (XIII) Q which can be set show the bivalence radical which cuts conjugated system, conjugate contains what depends on the un-existing-locally nature of a pi electron, and is depended on conjugated double bond, an unpaired electron, or a lone-pair electrons here. As an example of Q, it is [0023].

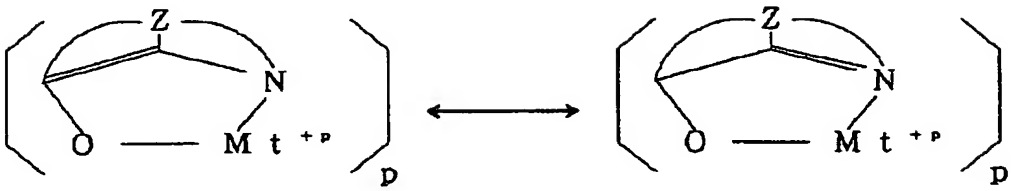
[Formula 3]



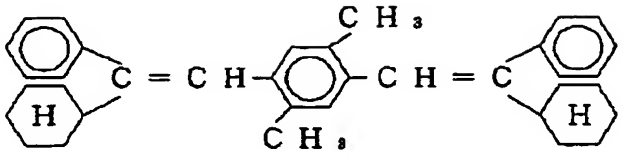
[0024] **** can be mentioned. Thus, the reason using the radical of the bivalence which cuts conjugated system is for making it EL luminescent color obtained when the compound [namely, the compound of a general formula (XI)] which forms A or B shown above is independently used as an organic EL device of this invention, and EL luminescent color obtained when ******** expressed with a general formula (XII) is used as an organic EL device of this invention not change. that is, the luminous layer using the compound expressed with a general formula (XI) or a general formula (XII) — short-wavelength-izing or a long wave — it is for merit-being made not toize. Moreover, if it connects by the bivalence radical which cuts conjugated system, it can check going up, a uniform pinhole free-lancer's microcrystal or amorphous nature thin film can be obtained, and glass transition temperature (Tg) will raise luminescence homogeneity. Furthermore, composition or purification is equipped with the advantage made easily, without EL luminescence forming long wavelength by having joined together by the bivalence radical which cuts conjugated system. Furthermore, the metal complex of 8-hydroxyquinoline or its derivative can be mentioned as a desirable thing of luminescent material (host ingredient). Specifically, it is a metal chelate oxy-NOIDO compound containing the chelate of an oxine (generally an eight quinolinol or 8-hydroxyquinoline). Such a compound shows the engine performance of a high level, and is easily fabricated by the thin film gestalt. the example of an oxy-NOIDO compound is ** which fills the following structure expression.

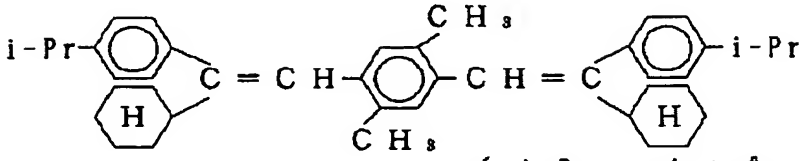
[0025]

[Formula 4]



[0026] Mt expresses a metal among [type and an atom required in order for p to be the integer of 1-3, and for each of the location of Z to be independent and to complete at least two or more fused aromatic rings is shown.] Here, the metals expressed with Mt are earth metals, such as alkaline earth metal, such as alkali metal, such as monovalence, bivalence or a trivalent metal, for example, a lithium, sodium, or a potassium, magnesium, or calcium, boron, or aluminum. Each the monovalence, the bivalence, or the trivalent metal known as it is generally a useful chelate compound can be used. Moreover, Z shows the atom in which the heterocycle which one side of at least two or more fused aromatic rings becomes from azole or an azine is made to form. Here, if required, it is possible to add the ring from which others differ to the above-mentioned fused aromatic ring. Moreover, in order to avoid adding a ******** molecule, with no improvement on a function, as for the number of the atoms shown by Z, carrying out to 18 or less is desirable. Furthermore, if a chelation oxy-NOIDO compound is illustrated concretely Tris Aluminum, a screw (Eight quinolinol) Magnesium, a screw (Eight quinolinol) Zinc, a screw (Benzo-eight quinolinol) (2-methyl-8-quinolilato)aluminumoxide, a tris (eight quinolinol) indium, tris (5-methyl-eight quinolinol) aluminum, an eight-quinolinol lithium, a tris (5-chloro-eight quinolinol) gallium, a screw (5-chloro-eight quinolinol) There are calcium, 5, 7-dichloro-eight-quinolinol aluminum, tris (5, 7-dibromo-8-hydroxy quinolinol) aluminum, etc.
[0027] as the formation approach of the above-mentioned luminous layer — vacuum deposition, a spin coat method, the cast method, and LB — although it can form by thin-film-izing by well-known approaches, such as law, it is desirable that it is especially the molecule deposition film. Here, molecule deposition film is the thin film which deposition was carried out and was formed from the gaseous-phase condition of this compound, and film solidified and formed from the melting condition or liquid phase condition of this compound. usually, this molecule deposition film — LB — it is distinguishable with the thin film (molecule built up film) formed of law, and the difference of condensation structure and higher order structure and the functional difference resulting from it. Moreover, after it melts the above-mentioned luminous layer to a solvent and it considers as a solution with binding material, such as resin, it can thin-film-ize this with a spin coat method etc., and can form it. The following compounds are mentioned as an ingredient of the luminous layer expressed with said general formula (XI) - (XIII).
[0028]
[Formula 5]





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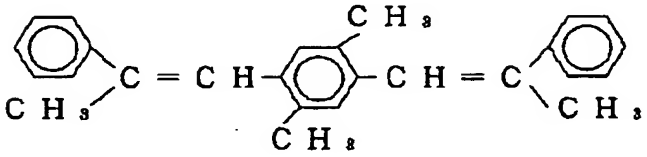
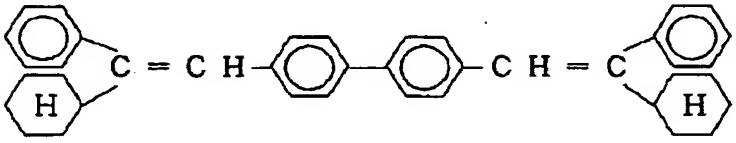
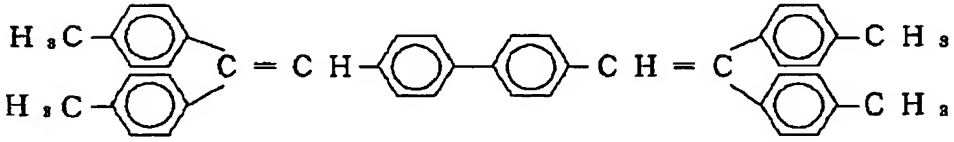
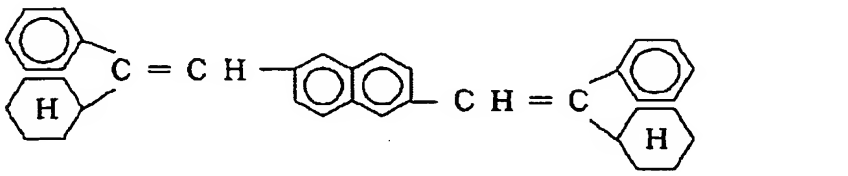
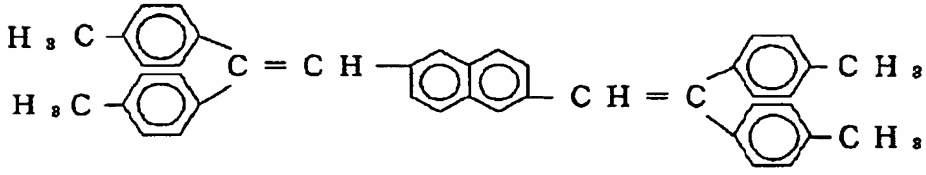


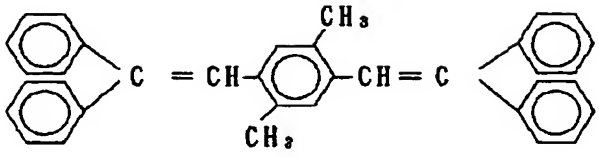


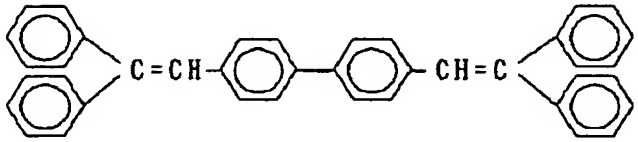


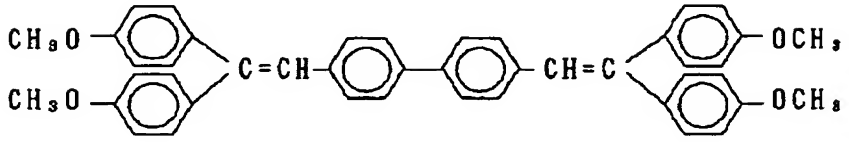


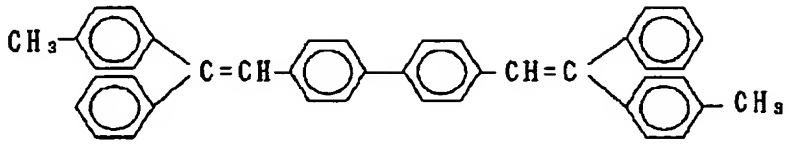


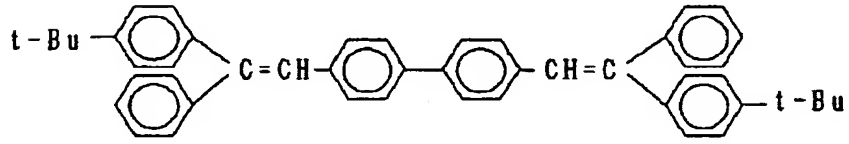
[0029]
[Formula 6]











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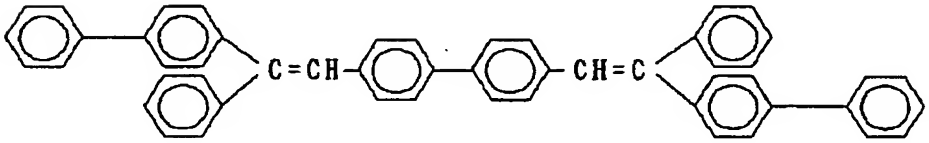
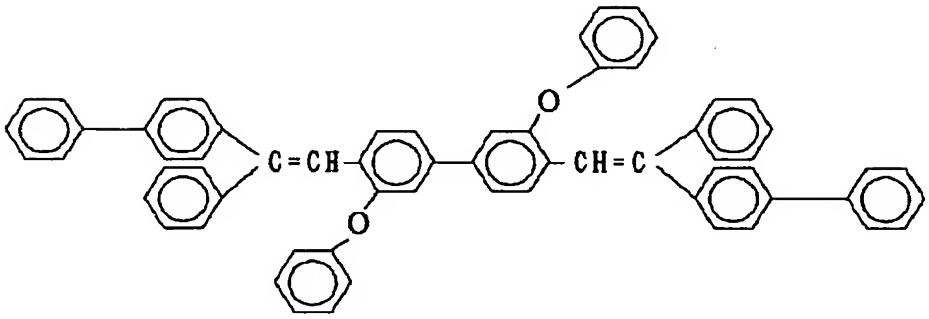
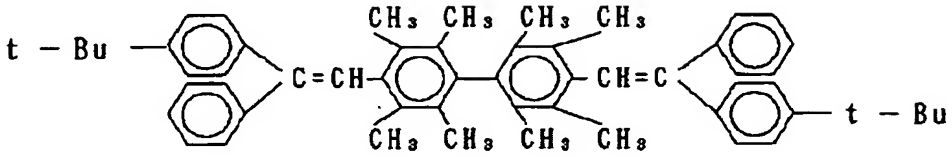
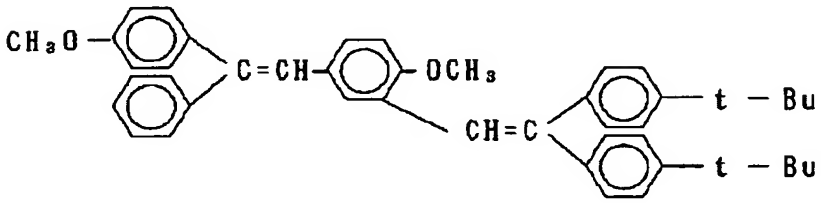
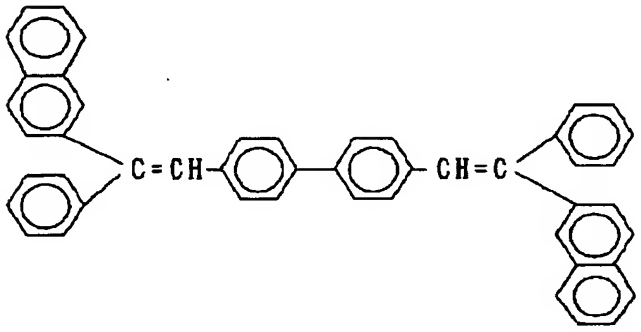


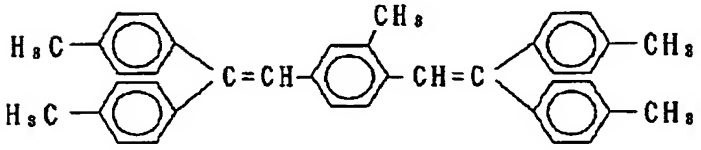


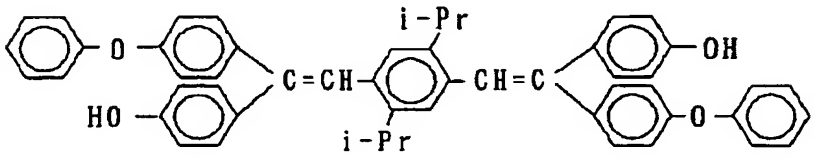
[0030]
[Formula 7]

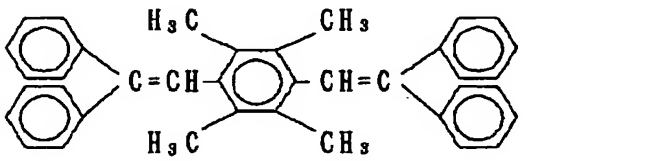




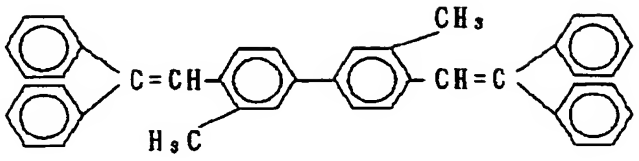


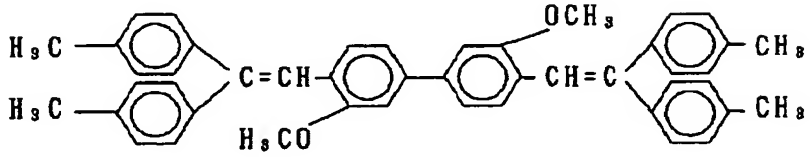


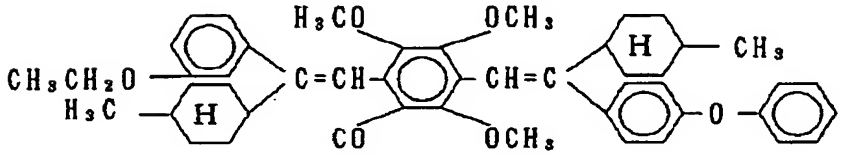


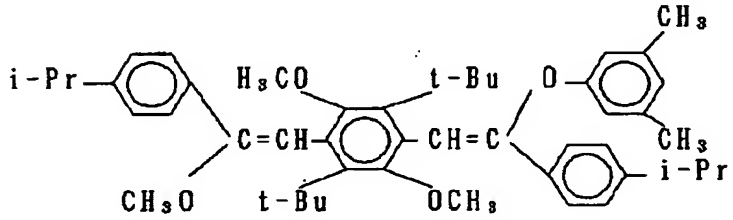


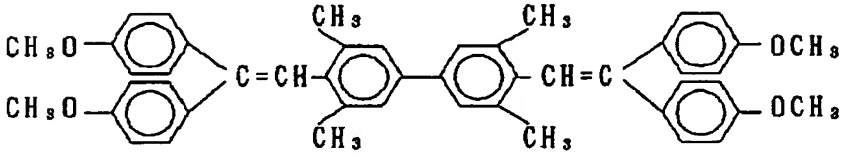
[0031]
[Formula 8]

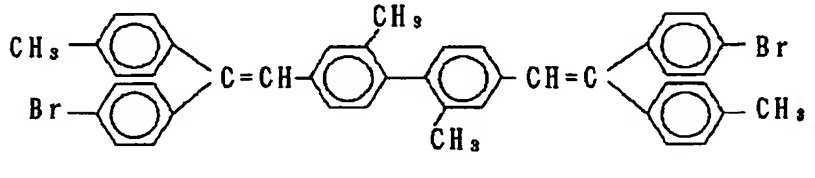


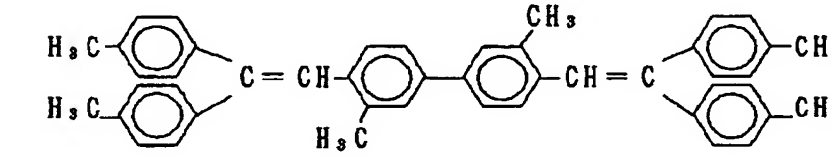




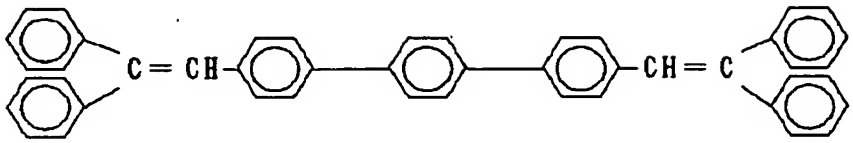


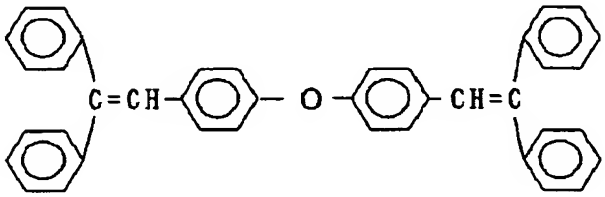


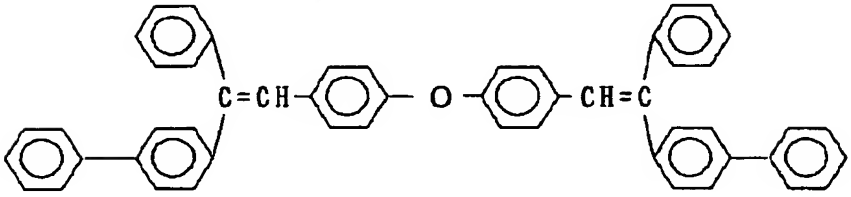


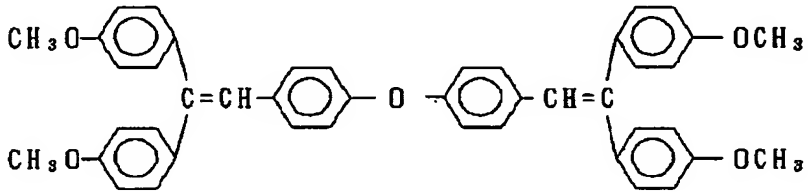


[0032]
[Formula 9]

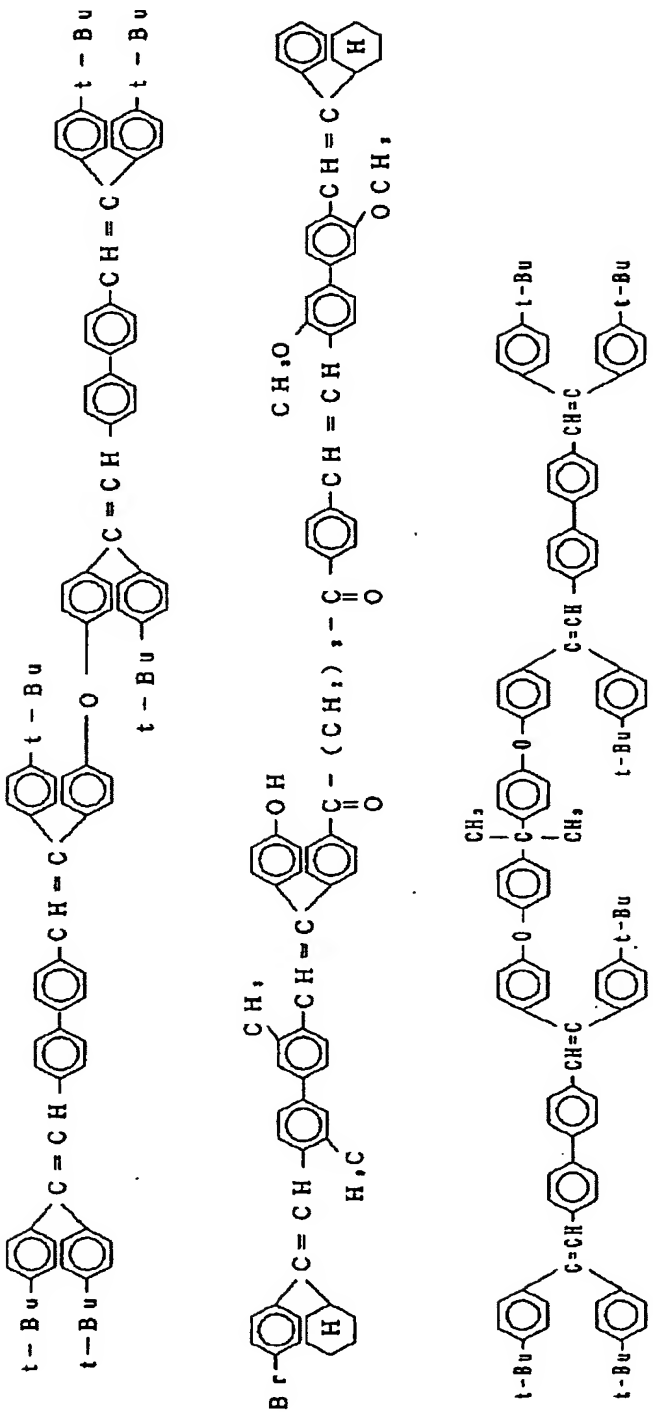




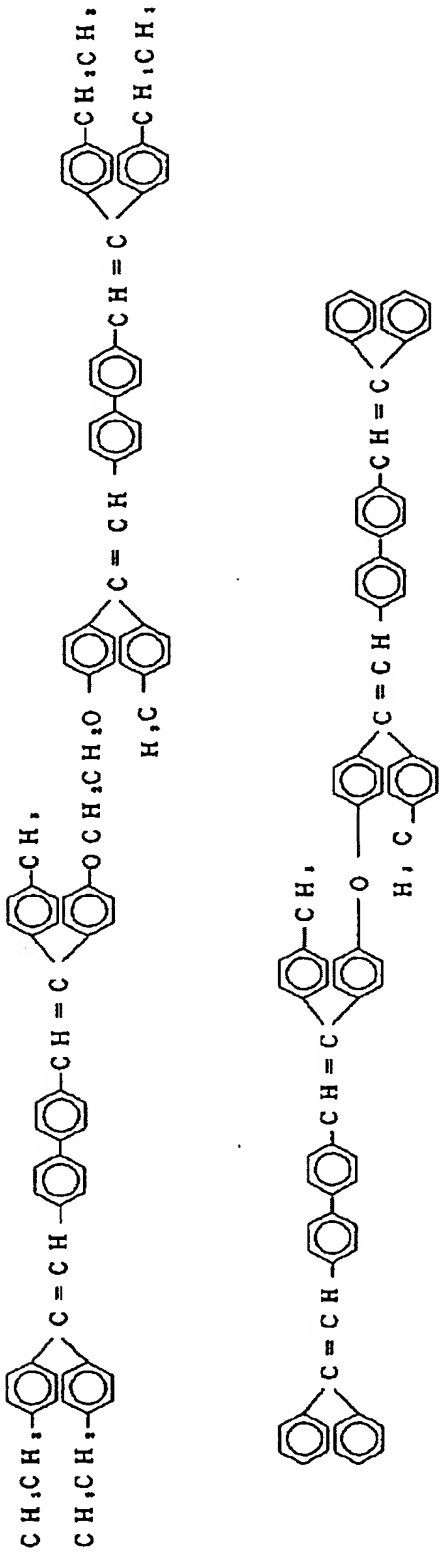




[0033]
[Formula 10]

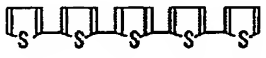


[0034]
[Formula 11]

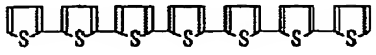


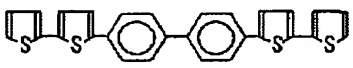
[0035] Next, although an electron hole transportation zone layer is not necessarily required for this component, it is more desirable to use for improvement in the luminescence engine performance. The ingredient which conveys an electron hole to a luminous layer by lower electric field as this electron hole transportation zone layer is desirable, and at the time of electric-field impression of 104 - 106 V/cm, if the mobility of an electron hole is 10-6cm2 / V, and a second at least, in addition, it is still more desirable. Moreover, since the electron is stopped in the luminous layer, an electronic barrier layer can be used between a luminous layer and an anode plate (transparent electrode). About such an electron hole transport ingredient, if it has the aforementioned desirable property, there is especially no limit, and it can choose and use the thing of arbitration in photoconductive material conventionally out of what is commonly used as charge transport material of an electron hole, or the well-known thing used for the electron hole

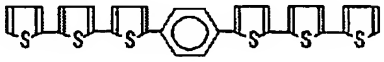
transportation zone layer of an EL element.
[0036] As this electron hole transport ingredient, for example A triazole derivative (reference, such as a U.S. Pat. No. 3,112,197 description), An OKISA diazole derivative (reference, such as a U.S. Pat. No. 3,189,447 description), An imidazole derivative (reference, such as JP,37-16096,B), the poly aryl alkane derivative (the [United States patent] — 3,615,402) a number description — this 3,820,989 a number description — this 3,542,544 Reference, such as a number description, JP,45-555,B, a 51-10983 official report, JP,51-93224,A, a 55-17105 official report, a 56-4148 official report, a 55-108667 official report, a 55-156953 official report, and a 56-36656 official report, A pyrazoline derivative and a pyrazolone derivative (the [United States patent] — 3,180,729) a number description — this 4,278,746 A number description, JP,55-88064,A, a 55-88065 official report, a 49-105537 official report, a 55-51086 official report, a 56-80051 official report, a 56-88141 official report, a 57-45545 official report, a 54-112637 official report, Reference, such as a 55-74546 official report, A phenylenediamine derivative (reference, such as a U.S. Pat. No. 3,615,404 description, JP,51-10105,B, a 46-3712 official report, a 47-25336 official report, JP,54-53435,A, a 54-110536 official report, and a 54-119925 official report), an arylamine derivative (the [United States patent] — 3,567,450) a number description — this 3,180,703 a number description — this 3,240,597 a number description — this 3,658,520 a number description — this 4,232,103 a number description — this 4,175,961 a number description — said — 4,012,376 A number description, JP,49-35702,B, a 39-27577 official report, JP,55-144250,A, a 56-119132 official report, a 56-22437 official report, and West German patent 1,110,518th Reference, such as a number description An amino permutation chalcone derivative (reference, such as a U.S. Pat. No. 3,526,501 description), An oxazole derivative (thing given in a U.S. Pat. No. 3,257,203 description etc.), A styryl anthracene derivative (reference, such as JP,56-46234,A), full — me — non — a derivative (reference, such as JP,54-110837,A) — a hydrazone derivative (the [United States patent] — 3,717,462) Reference, such as a number description, JP,54-59143,A, a 55-52063 official report, a 55-52064 official report, a 55-46760 official report, a 55-85495 official report, a 57-11350 official report, and a 57-148749 official report, A stilbene derivative JP,61-210363,A, a 61-228451 official report, a 61-14642 official report, a 61-72255 official report, a 62-47646 official report, a 62-36674 official report, a 62-10652 official report, and a 62-30255 official report — Reference, such as a 60-93445 official report, a 60-94462 official report, a 60-174749 official report, and a 60-175052 official report, etc. can be mentioned. furthermore, a silazane derivative (U.S. Pat. No. 4,950,950 description), a polysilane system (JP,2-204996,A), an aniline system copolymer (JP,2-282263,A), and conductive polymer oligomer (publication-number 1-No. 211399 official report) — ** thiophene oligomer etc. is mentioned especially.
[0037] In this invention, although these compounds can be used as an electron hole transport ingredient The porphyrin compound shown below (thing given in JP,63-2956965,A etc.), An aromatic series tertiary-amine compound and a styryl amine compound (the [United States patent] — 4,127,412) A number description, JP,53-27033,A, a 54-58445 official report, a 54-149634 official report, a 54-64299 official report, a 55-79450 official report, a 55-144250 official report, a 56-119132 official report, a 61-295558 official report, It is desirable reference, such as a 61-98353 official report and a 63-295695 official report, and to use this aromatic series tertiary-amine compound especially. As an example of representation of this porphyrin compound Porphin, 1, 10 and 15, 20-tetrapod phenyl-21H, 23H-porphin copper (II);1, 10 and 15, 20-tetrapod phenyl 21H, 23H-porphin zinc (II);5, 10 and 15, 20-tetrakis (pentafluorophenyl)-21H, 23H-porphin; Silicon phthalocyanine oxide; Aluminum phthalocyanine chloride; A phthalocyanine ; (Non-metal) Dilithium phthalocyanine; copper tetramethyl phthalocyanine; — copper-phthalocyanine; — chromium phthalocyanine; — zinc phthalocyanine; — lead phthalocyanine; — titanium phthalocyanine oxide; — magnesium phthalocyanine; — a copper octamethyl phthalocyanine etc. is mentioned.
[0038] moreover, as an example of representation of this aromatic series tertiary-amine compound and a styryl amine compound N, N, N', and N' - tetra-phenyl - 4 and 4 - diamino phenyl, and 'N, N' - diphenyl-N and N' - JI (3-methylphenyl) -4 and 4' — a - diamino biphenyl, 2, and 2-bis(4-G p-tolylamino phenyl) propane and 1 — 1-screw (4-G p-tolylamino phenyl) a cyclohexane, N and N, N', and N' — the - tetra—p-tolyl -4 and 4' - diamino biphenyl, 1, and 1-bis(4-G p-tolylamino phenyl)-4-phenylcyclohexane — a screw (4-dimethylamino-2-methylphenyl) a phenylmethane, a bis(4-G p-tolylamino phenyl) phenylmethane, N, and N' - diphenyl-N and N' - JI (4-methoxypheny) - 4 and 4 - diamino biphenyl, and 'N, N, N' — N'-tetrapod phenyl -4, 4'-diamino diphenyl ether, 4, and 4 '- bis(diphenylamino) KUODORI phenyl, N and N, N-Tori (P-tolyl) amine, and 4-(G p-tolylamino)-4'-[4 (G p-tolylamino) Styryl] stilbene, 4-N and N-diphenylamino-(2-diphenyl vinyl) benzene, 3-methoxy-4'-N, and N-diphenylamino still benzene, N-phenyl carbazole, an aromatic series JIMECHIRI DIN system compound, etc. are mentioned.
[0039] this electron hole transportation zone layer in the EL element of this invention — the above-mentioned compound — for example, a vacuum deposition method, a spin coat method, and LB — a film can be produced with well-known film methods, such as law, and it can form. The thickness of this electron hole transportation zone layer is usually 5nm - 5 micrometers, although there is especially no limit. This electron hole transportation zone layer may consist of one layer which consists of the above-mentioned electron hole transport ingredient kinds or two sorts or more, or may carry out the laminating of the electron hole transportation zone layer which consists of a compound of another kind to said electron hole transportation zone layer.
[0040] Furthermore, as an ingredient of an organic-semiconductor layer, it is [0041], for example.
[Formula 12]

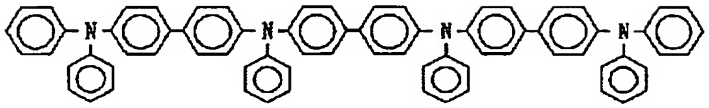
(1) 

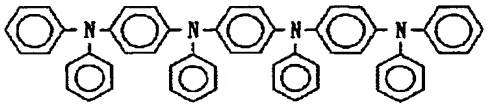
(2) 

(3) 

(4) 

(5) 

(6) 

(7) 

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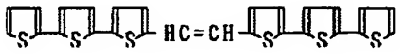
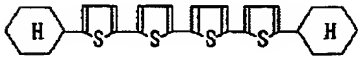
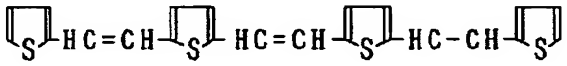
(9) 

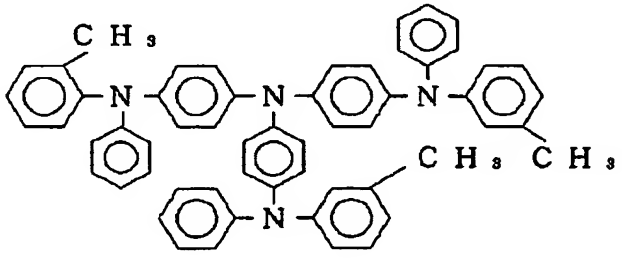
(10) 

(11) 

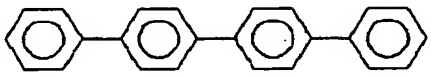
[0042]
[Formula 13]
(12) 

(13) 

(14) 

(15) 

[0043] **** can be mentioned.
[0044] On the other hand, as an ingredient of an electronic barrier layer, it is [0045], for example.
[Formula 14]
(1)



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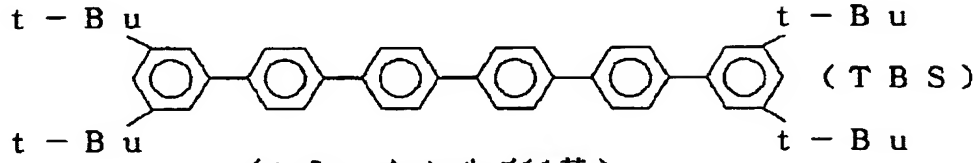
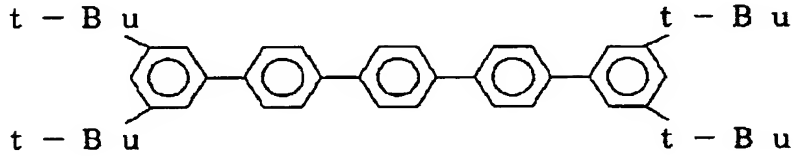
(3)



（t-Bu：ターシャリーブチル基）

(4)



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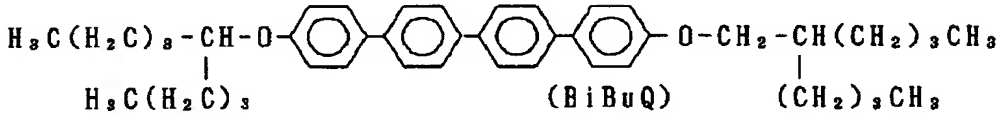

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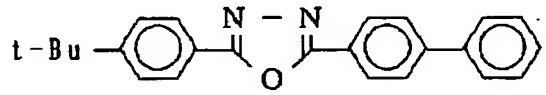
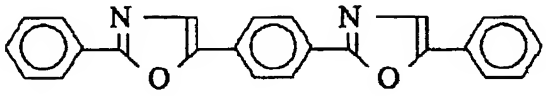


(t-Bu PBD)

(7)



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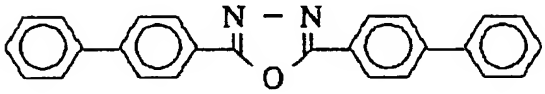
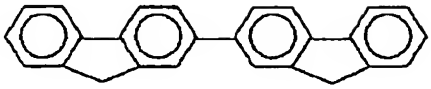


[0046]
[Formula 15]

(9)



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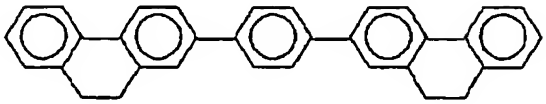

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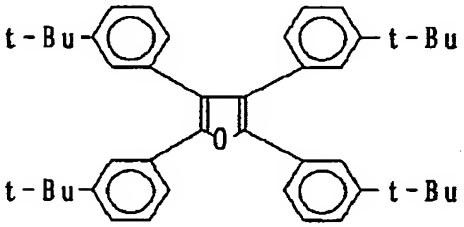
(12)



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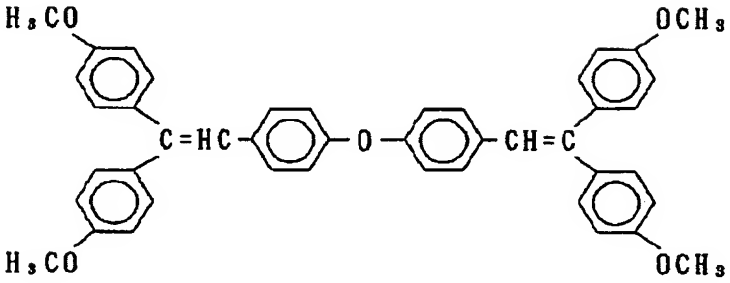

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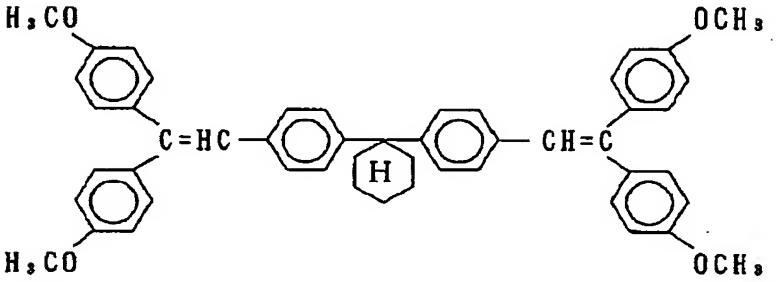
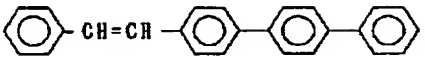


[0047]
[Formula 16]

(15)



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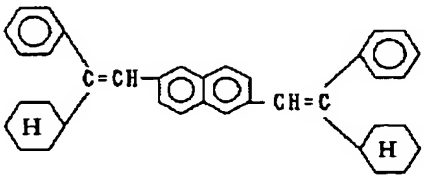
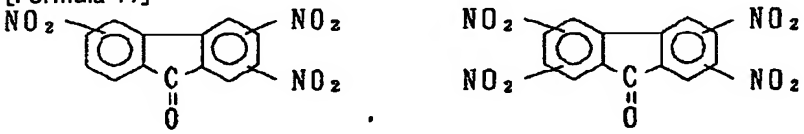
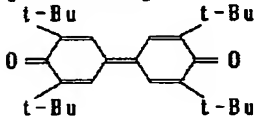


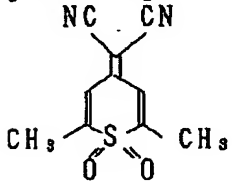
[0048] **** can be mentioned.
[0049] Moreover, the electronic injection layer in this organic multilayer section consists of an electron injection ingredient, and it has the function to be at a luminous layer and to transmit the electron poured in from cathode. There is especially no limit about such an electron injection ingredient, and the thing of arbitration can be conventionally chosen and used out of a well-known compound. As a desirable example of this electron injection ingredient, it is [0050].
[Formula 17]



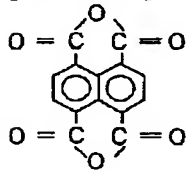
[0051] which nitration full — me — non — the anthra quinodimethan derivative indicated by a derivative, JP,57-149259,A, 58-55450, the 63-104061 official report, etc., and "polymer pre PURINTSU and Japan (Polymer Preprints, Japan)" — [0052] indicated by the 37th volume, No. 3, the 681st page (1988), etc.
[Formula 18]



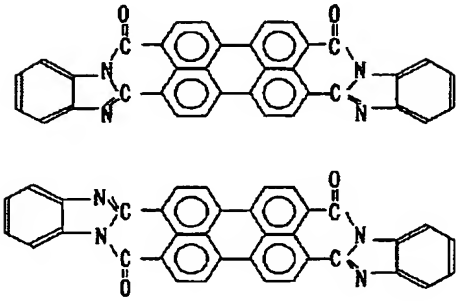
[0053] Which diphenyl quinone derivative [0054]
[Formula 19]



[0055] Which thiopyran dioxide derivative [0056]
[Formula 20]

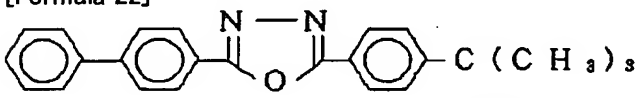


[0057] Heterocycle tetracarboxylic acid anhydrides, such as which naphthalene perylene, or a carbodiimide is mentioned. furthermore, "Journal of Applied Physics (J.Appl.Phys.)" — [0058] indicated by the 27th volume, the 269th page (1988), etc.
[Formula 21]



[0059] the anthra quinodimethan derivative indicated by the deflection ORENIRIDEN methane derivative which comes out and is indicated by the compound and JP,60-69657,A which are expressed, 61-143784, the 61-148159 official report, etc., JP,61-225151,A, the 61-233750 official report, etc. and an anthrone derivative, and "applied FIJIKUSU Letters (Appl.Phys.Lett.)" — the 55th volume and the following OKISA diazole derivative [0060] indicated by the 1489th page (1989)

[Formula 22]

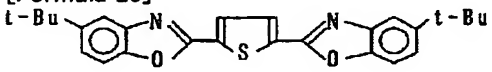


P B D

[0061] **** can be mentioned. Moreover, although a series of electron transport nature compounds indicated by JP,59-194393,A were indicated in this official report as an ingredient which forms a luminous layer, examination of this invention persons showed that it could use as an ingredient which forms an electronic injection layer. It is

[0062] especially.

[Formula 23]



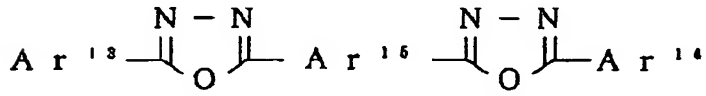
B B O T

[0063] It comes out and the compound expressed is suitable. the electronic injection layer in the organic EL device of this invention — the above-mentioned compound — for example, a vacuum deposition method, a spin coat method, the cast method, and LB — a film can be produced by the thin film-ized method law etc. is well-known, and it can form. The thickness as an electronic injection layer is usually chosen in 5nm - 5 micrometers. This electronic injection layer may consist of one layer which consists of these electron injection ingredient kinds or two sorts or more, or may carry out the laminating of the electronic injection layer which consists of a compound of another kind to this layer.

[0064] Furthermore, what is excellent in electron transport nature, and contains an adhesive high ingredient to a luminous layer and cathode as an adhesion improvement layer in this organic multilayer section is desirable. As such an ingredient, the metal chelate oxy-NOIDO compound which contains 8-hydroxyquinoline or the metal complex of the derivative, for example, the chelate of an oxine (generally an eight quinolinol or 8-hydroxyquinoline), for example is mentioned. Specifically, the complex of indiums other than aluminum, magnesium, copper, a gallium, tin, and lead etc. can be mentioned to tris (eight quinolinol) aluminum, tris (5, 7-dichloro-eight quinolinol) aluminum, tris (5, 7-dibromo-eight quinolinol) aluminum, tris (2-methyl-eight quinolinol) aluminum, and a list. Moreover, an OKISA diazole derivative is also suitable and they are a general formula (XIV) and (XV) [0065] as this OKISA diazole derivative.

[Formula 24]

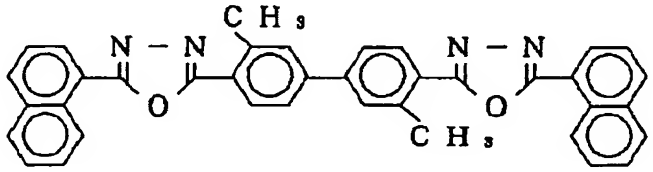
・・・ (XIV)

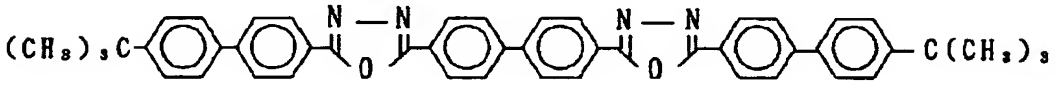


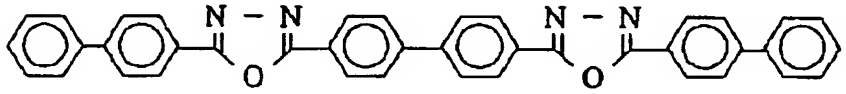
・・・ (XV)

[0066] Ar11-Ar14 show among [type the aryl group which is not permuted [a permutation or], respectively, even if Ar11, Ar12, and Ar13 and Ar14 are mutually the same in each, you may differ, and Ar15 shows the arylene radical which is not permuted [a permutation or].] It comes out and the electron transport compound expressed is mentioned. Here, as an aryl group, a phenyl group, a biphenyl radical, an anthranil, a peri RENIRU radical, a pyrenyl radical, etc. are mentioned, and a phenylene group, a naphthylene radical, a biphenylene radical, an anthracenylene group, a peri RENIREN radical, a pyrenylene radical, etc. are mentioned as an arylene radical. Moreover, as a substituent, the alkyl group of carbon numbers 1-10, the alkoxy group of carbon numbers 1-10, or a cyano group is

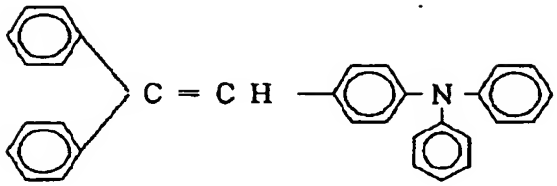
mentioned. This electron transport compound has the desirable thing of a thin film plasticity. The above mentioned PBD is begun as an example of this electron transport compound, and it is [0067].
[Formula 25]

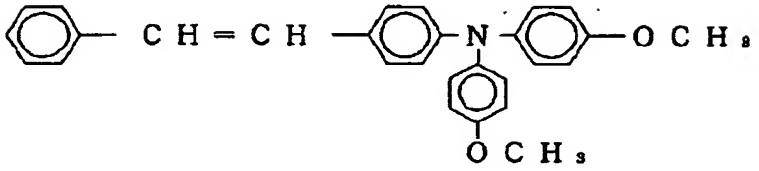


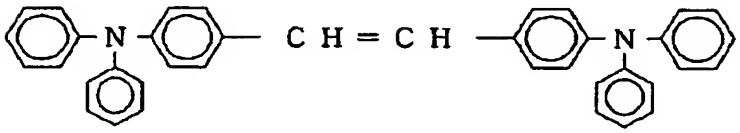


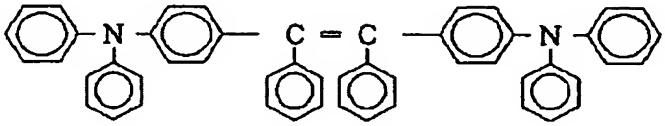


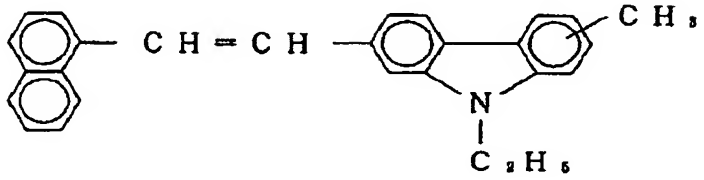
[0068] It comes out and the compound expressed is mentioned. the adhesion improvement layer in the organic EL device of this invention — the above-mentioned compound — for example, a vacuum deposition method, a spin coat method, the cast method, and LB — a film can be produced by the thin film-ized method law etc. is well-known, and it can form. The thickness as an adhesion improvement layer is usually chosen in 5nm - 5 micrometers. This adhesion improvement layer may consist of one layer which consists of these adhesive ingredient kinds or two sorts or more, or may carry out the laminating of the adhesion improvement nature which consists of a compound of another kind to this layer. such an adhesion improvement layer consists of an adhesive high electron transport compound, and comes out not to mention playing a role of an electronic injection layer. In addition, the technique which monolayer-izes the organic multilayer section is well-known, and in this technique, an electron hole transport ingredient, luminescent material, an electron injection ingredient, etc. are mixed, for example in binders, such as polystyrene, a polycarbonate, and a polyvinyl carbazole, it equalizes, and the monolayer which consists of this thing is made to form between an anode plate (transparent electrode) and cathode. This monolayer-ized technique is indicated by the 40th volume and the 3591st page for example, in "collection of Japanese Society of Polymer Science, Japan drafts" 1991. In this invention, it can replace with the organic multilayer section and the organic monolayer section by this technique can be used.
[0069] In case an electron hole is poured into the organic multilayer section of this invention from the outer layer section, charge impregnation nature is raised more with the same field strength, and in order to pour in more amounts of charges, a charge impregnation nominal member may be used. the addition to each class of the organic multilayer section of this charge impregnation nominal member — desirable — 19 or less % of the weight of the weight of each class — especially — desirable — 0.05 - 9 % of the weight — it is . Here, explanation of the function of a charge impregnation nominal member etc. is as being indicated by the international applications PCT/JP 93/01198. Specifically, as for the electron-donative stilbene derivative, JISUCHIRIRU arylene derivative, or tris styryl arylene derivative used as a charge impregnation nominal member, the following compound is mentioned.
[0070]
[Formula 26]

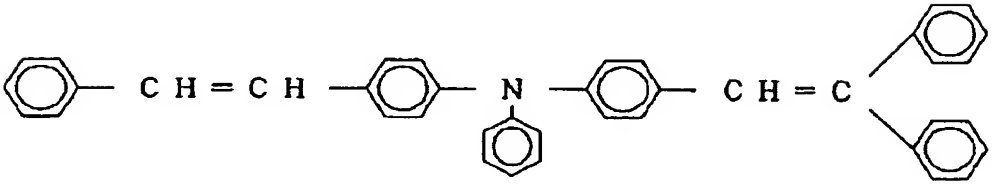


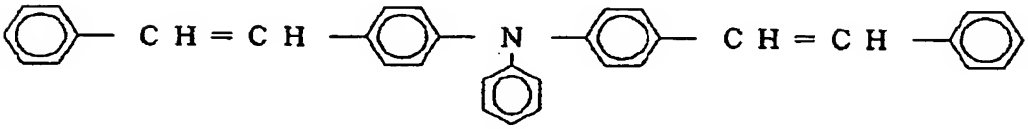




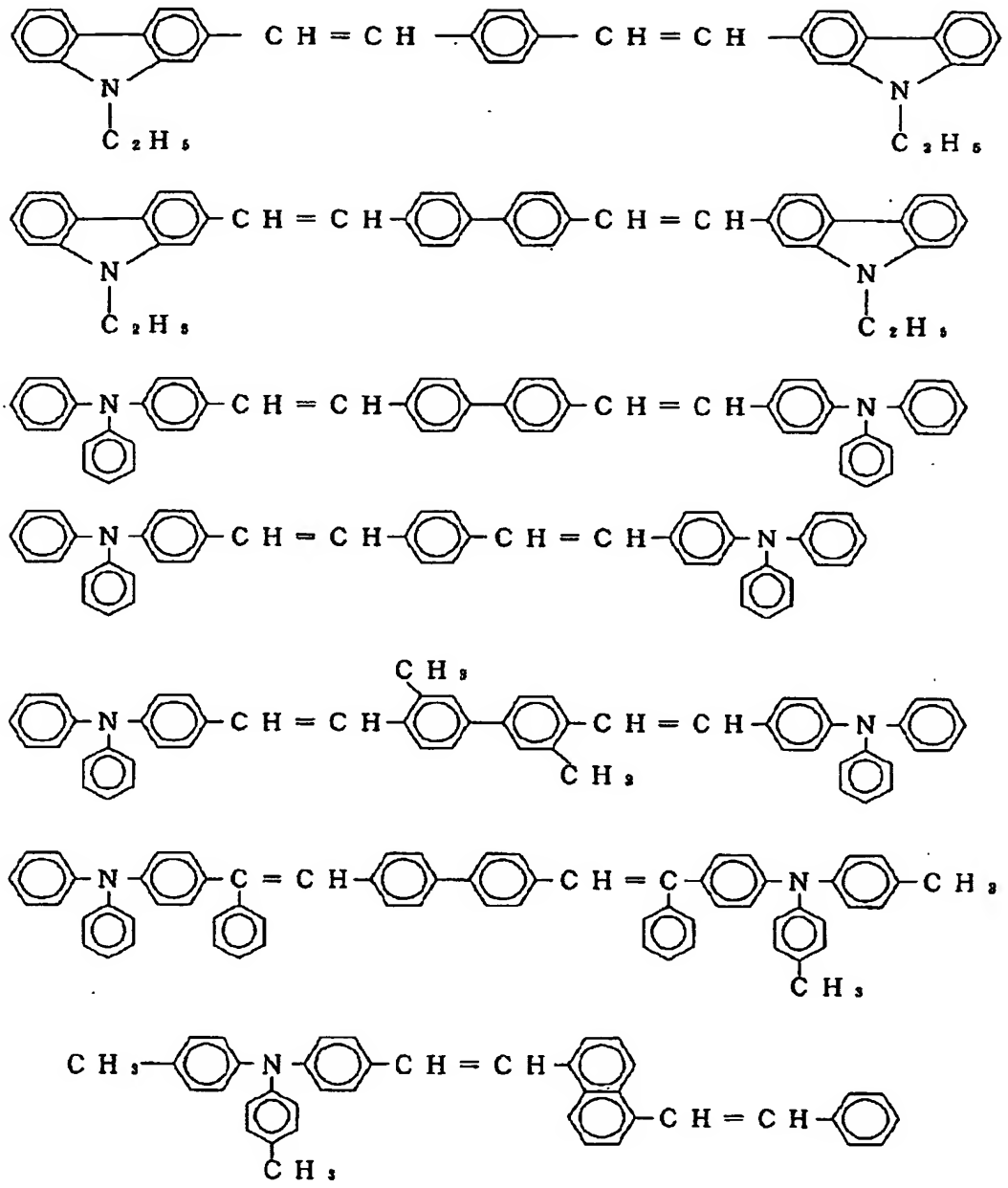




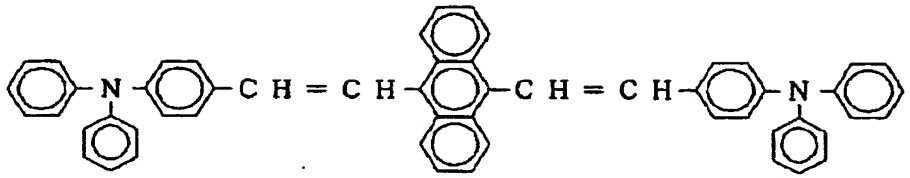


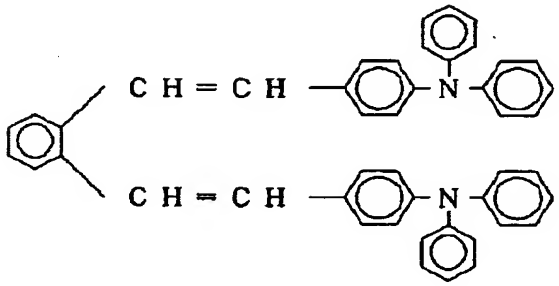


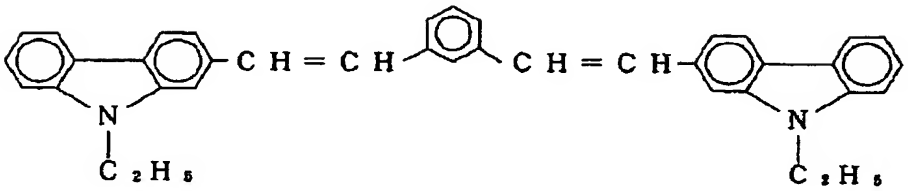
[0071]
[Formula 27]

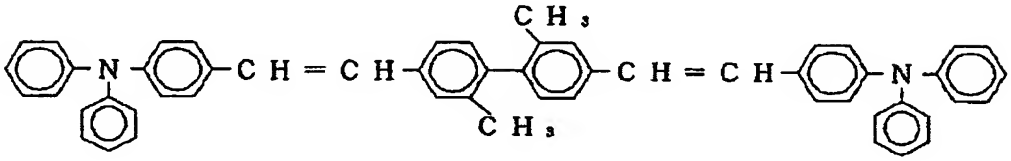


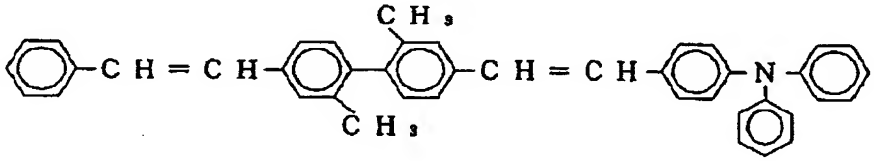
[0072]
[Formula 28]



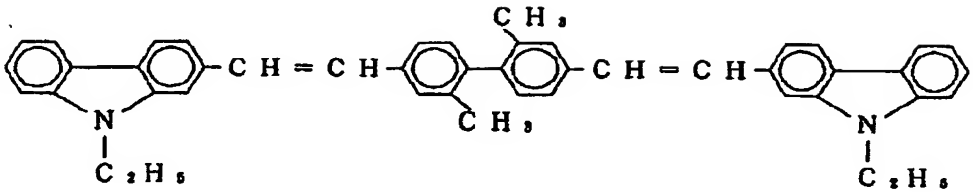


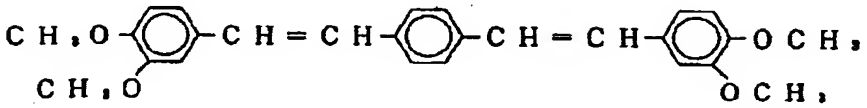


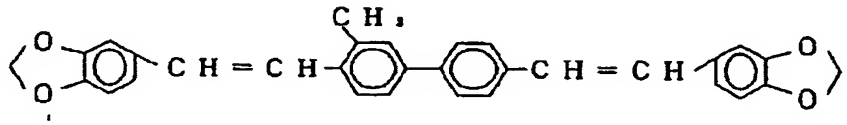


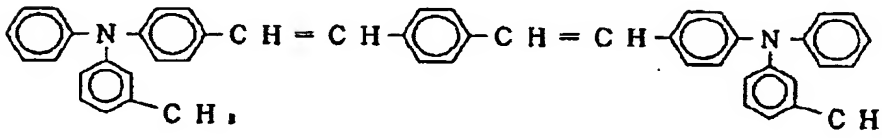


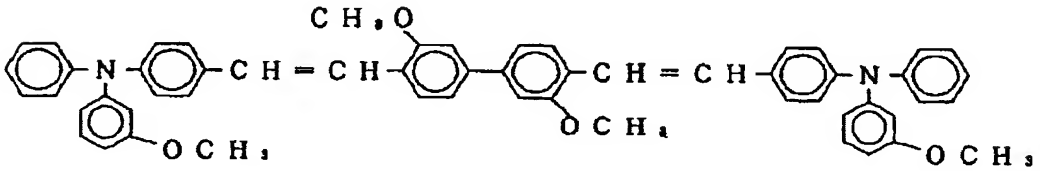
[0073]
[Formula 29]

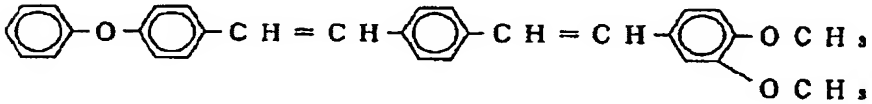


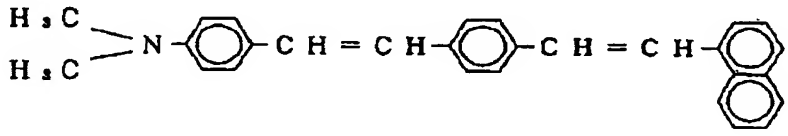




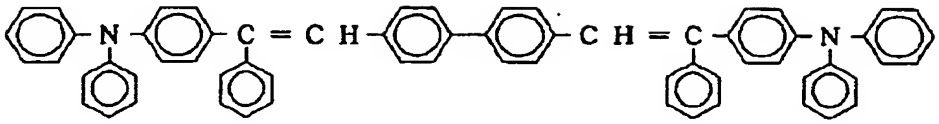


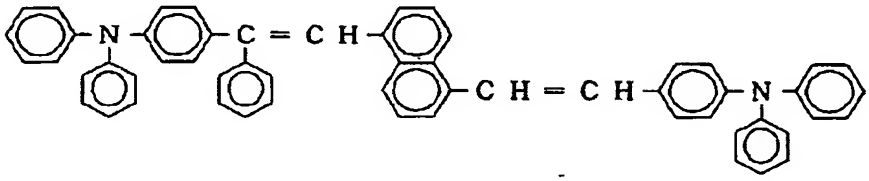


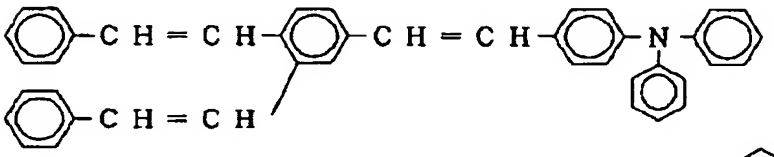


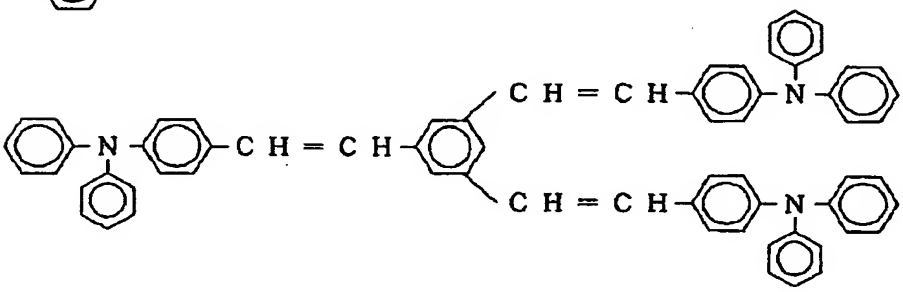


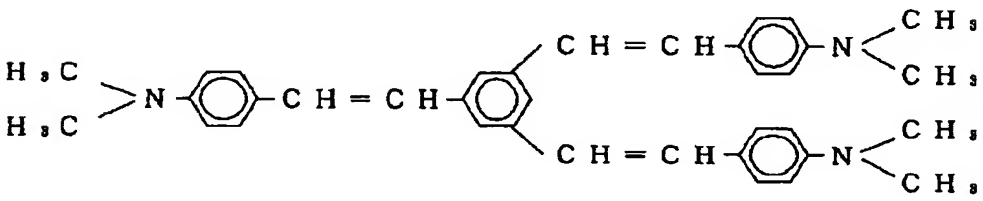
[0074]
[Formula 30]



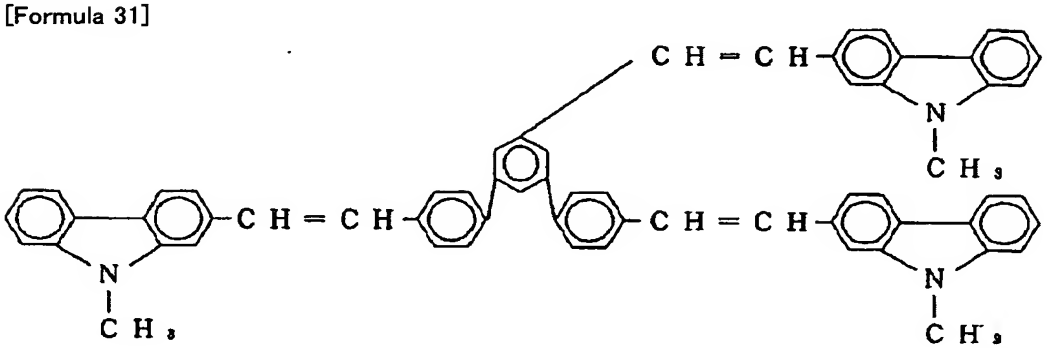


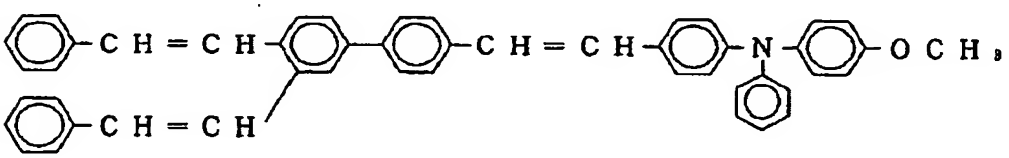


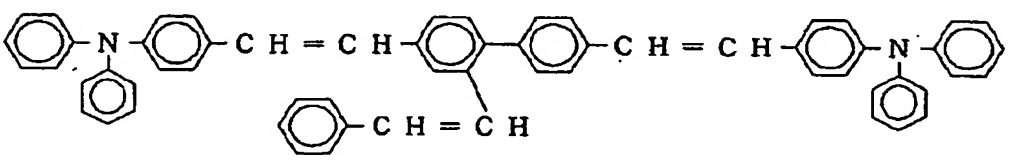




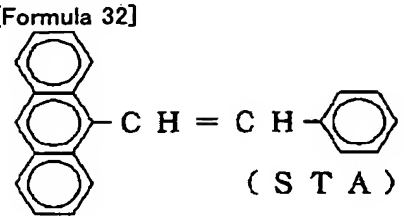
[0075]
[Formula 31]



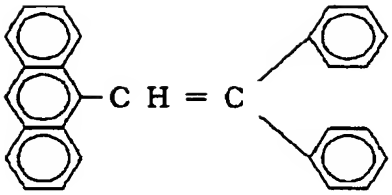


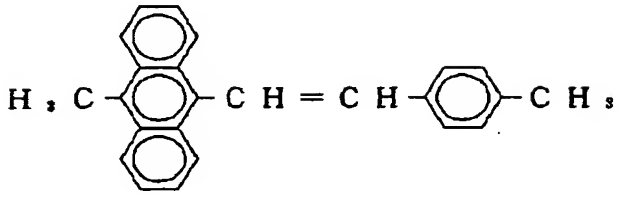


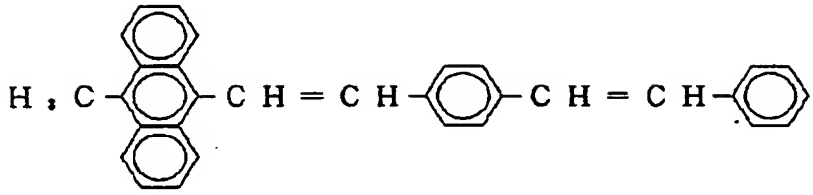
[0076]
[Formula 32]

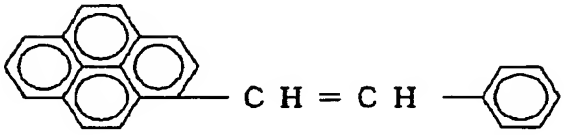


(STA),

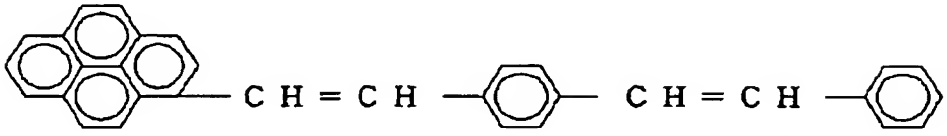








(STPy)



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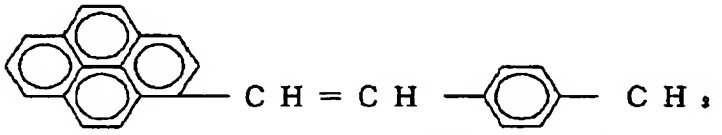

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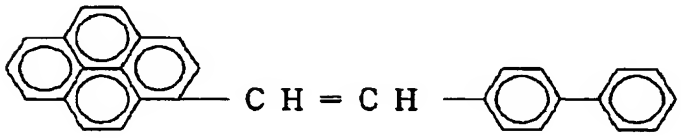
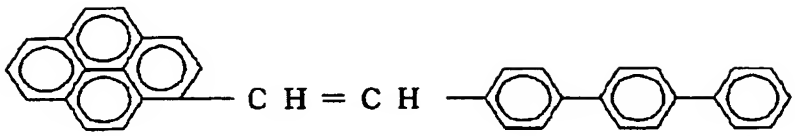
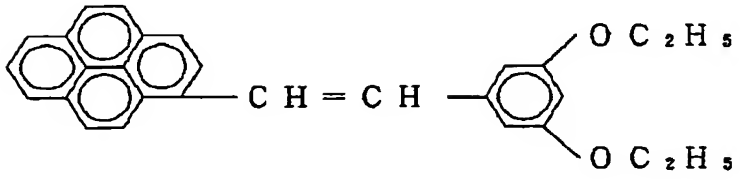
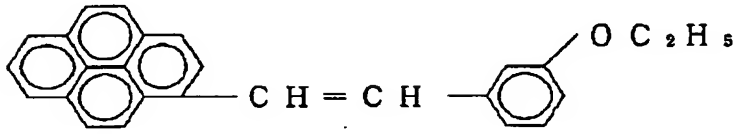
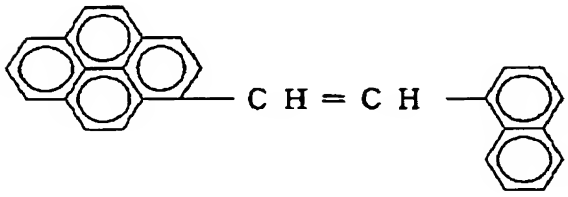


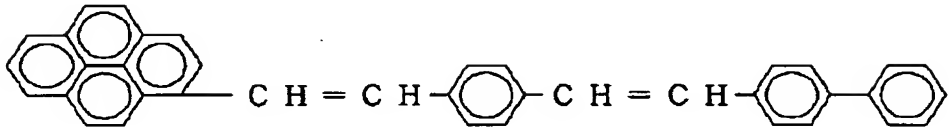
[0077]
[Formula 33]

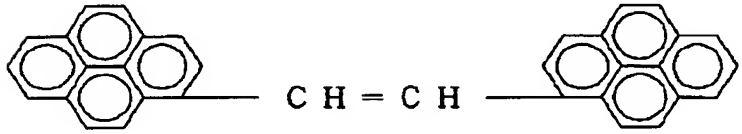


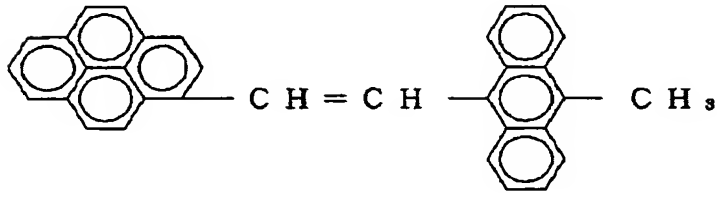




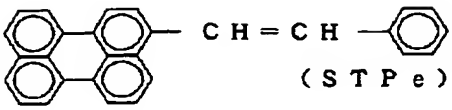


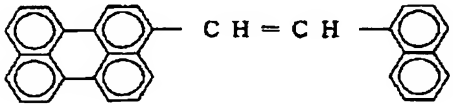


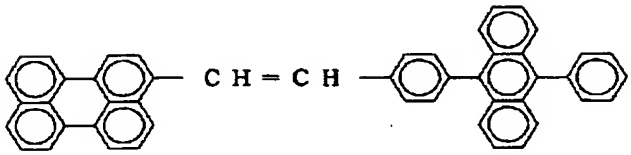


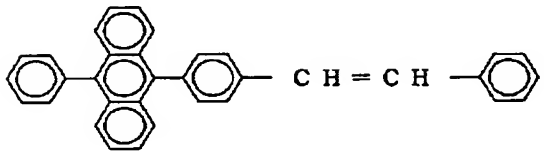


[0078]
[Formula 34]









[0079] Next, after making the matter for anode plates form by approaches, such as vacuum evaporationo and sputtering, so that it may become desired thickness and producing a transparent electrode (anode plate) on a suitable substrate, each thin film which consists of an electron hole transport ingredient, luminescent material, and an electron injection ingredient is made to form on this first, if the configuration of a substrate / transparent electrode / electron hole transportation zone layer / luminous layer / electronic injection layer / cathode is mentioned as an example and the suitable method of producing the EL element of this invention is explained. As the approach of this thin-film-izing, although there are a spin coat method, the cast method, vacuum deposition, etc., the point of the homogeneous film being easy to be obtained and being hard to generate a pinhole to a vacuum deposition method is desirable. When adopting this vacuum deposition as this thin film-ization, although it changes with crystal structures, meeting structures, etc. which are made into the class of compound to be used, and the object of the molecule deposition film, as for that vacuum evaporationo condition, it is desirable to choose suitably whenever [boat stoving temperature] generally in 50-450 degrees C, a 10-5 to ten to 8 Pa degree of vacuum, an evaporation rate 0.01 - 50 nm/sec, the substrate temperature of -50-300 degrees C, and the range of 5nm - 5 micrometers of thickness. Next, a desired EL element is obtained by making 10-500nm of thin films which consist of matter for cathode on it form by approaches, such as vacuum evaporationo and sputtering, after formation of these layers, so that it may become the thickness of the range of 50-200nm preferably, and preparing cathode. Thus, if + is impressed for an anode plate and it impresses about electrical-potential-difference 5-40V for cathode as a polarity of - in impressing direct current voltage to the obtained EL element, high luminescence of color purity can be observed. Moreover, even if it impresses an electrical potential difference with the polarity of reverse, luminescence is not produced at all, without a current flowing. Furthermore, in impressing alternating voltage, only when an anode plate changes + and cathode changes into the condition of -, it emits light. In addition, the wave of the alternating current to impress is arbitrary and good.

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

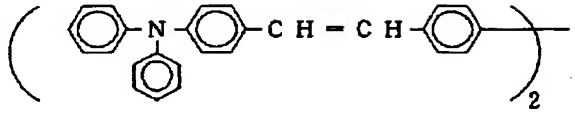
EXAMPLE

[Example] Furthermore, although an example explains this invention to a detail, this invention is not limited at all by these examples.
What produced ITO by the thickness of anm with vacuum deposition on examples 1-3, and 25mm x75mmx the 1.1mm glass substrate [the product made from Japanese Sheet glass and OA-2] of production of the example 1-3 (1) EL element of a comparison [JIOMA tick company make] was used as the transparence support substrate. In addition, in isopropyl alcohol, after ultrasonic cleaning and nitrogen are sprayed, it dries for 5 minutes, and this substrate performs UV ozone washing [UV300 and SAMUKO international company make] for 10 minutes. This transparence support substrate is fixed to the substrate electrode holder of commercial vacuum evaporationo equipment [the product made from Japanese Vacuum technology]. N, N'-bis(3-methylphenyl)-N, N'-diphenyl (1 and 1'-biphenyl) -4, and 200mg (TPD) of 4'-diamines are put into the resistance heating boat made from molybdenum. The compound which 200mg (DPVBi) of 4 and 4'-bis(2 and 2'-diphenyl vinyl) biphenyls is put into other resistance heating boats made from molybdenum, and is a charge impregnation nominal member at the resistance heating boat made from molybdenum of further others (A) (it is shown in the 1st table.) 200mg was put in and the vacuum tub was decompressed up to 1x10 to 4 Pa. Said boat into which TPD went after that was heated to 215-220 degrees C, it vapor-deposited on the transparence support substrate with the evaporation rate of 0.1-0.3nm/second, and the hole injection layer of Thickness bnm was made to produce. At this time, the temperature of a substrate was a room temperature. It carried out the cnm laminating to the hole injection layer, having used DPVBi as the host ingredient, without taking this out from a vacuum tub. At this time, the boat of a compound (A) was heated to coincidence, and the compound (A) was mixed to the luminous layer. the evaporation rate at this time — the evaporation rate [(B) shown in the 1st table] of DPVBi — receiving — the evaporation rate of (A) — (C) — (— it is shown in the 1st table.) — ** — it carried out. Then, the vacuum tub was returned to the atmospheric pressure, the 8-hydroxyquinoline aluminum complex (Alq) which is the ingredient of a glue line was newly put into the resistance heating boat made from molybdenum, magnesium ribbon 1g was further put into the resistance heating boat made from molybdenum, 500mg of silver wires was put into the basket made from a tungsten, and the vacuum tub was decompressed up to 1x10 to 4 Pa. Subsequently, the 8-hydroxyquinoline aluminum complex (Alq) was vapor-deposited with the evaporation rate of 0.01-0.03nm/second, and dnm formation of the glue line was carried out. Furthermore, silver was carried out with the evaporation rate of 0.1nm/second, the simultaneous vacuum evaporationo of the magnesium was carried out with the evaporation rate of 1.4nm/second, and the silver:magnesium mixing electrode was used as cathode. Thickness was 150nm. In addition, the reflection factor of cathode was 85%. The thickness of each class is shown in the 2nd table. moreover — each class — a refractive index — separate — the — vacuum evaporationo — the film — receiving — an ellipsomter — having measured — a place — ITO — TPD — DPVBi (doped layer) — and — Alq — a layer — a refractive index — respectively — one . — 86 — one . — seven — 1.75 — and — 1.7 — it is — this — a value — being based — the above — a component — (— nd —) — one — (— nd —) — two — [— (— nd —) — one — + — (— nd —) — two —] — having asked — . These results are shown in the 3rd table with lambda and m.
[0081]
[A table 1]

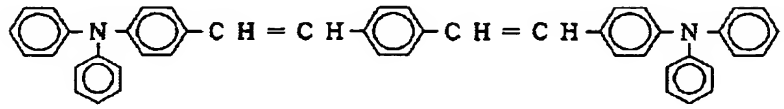
第 1 表

	(A)	(B) (nm/秒)	(C) (nm/秒)
実施例1	PAVBi	2.8～3.5	0.075
実施例2	PAVB	3.2～3.4	0.10
実施例3	PAVTP	2.7～3.5	0.13
比較例1	PAVBi	2.5～3.0	0.09
比較例2	PAVB	3.0～4.0	0.09
比較例3	PAVTP	2.7～3.5	0.13

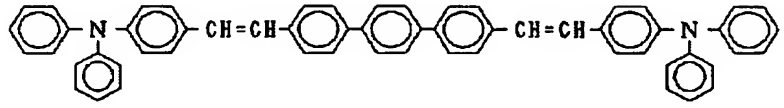
[0082]
[Formula 35]
P A V B i :



P A V B :



P A V T P :



[0083]
[A table 2]

第 2 表

	各層の膜厚（ｎｍ）			
	a	b	c	d
実施例１	１２０	８０	４０	２０
実施例２	１２０	８０	４０	２０
実施例３	１００	１１０	４０	２０
比較例１	１００	６０	４０	２０
比較例２	１００	６０	４０	２０
比較例３	１００	８０	４０	２０

[0084]
[A table 3]

第 3 表－1

	光学膜厚		
	有機多層部 $(nd)_1$	透明電極 $(nd)_2$	$[(nd)_1 + (nd)_2]$
実施例1	80 ×1.7 +40×1.75 +20×1.7	120 ×1.86	463
実施例2	80 ×1.7 +40×1.75 +20×1.7	120 ×1.86	463
実施例3	110 ×1.7 +40×1.75 +20×1.7	100 ×1.86	477
比較例1	60 ×1.7 +40×1.75 +20×1.7	100 ×1.86	392
比較例2	60 ×1.7 +40×1.75 +20×1.7	100 ×1.86	392
比較例3	80 ×1.7 +40×1.75 +20×1.7	100 ×1.86	426

[0085]
[A table 4]

第 3 表－2

	λ (nm)	m
実施例1	463	2
実施例2	463	2
実施例3	477	2
比較例1	392	2
比較例2	392	2
比較例3	426	2

[0086] Although lambda is filling the formula of 4 pi/lambda [(nd)1+(nd)2] =2mpi (m= 2) with examples 1-3 to blue wavelength, in the examples 1-3 of a comparison, lambda has shifted from blue wavelength (blue wavelength: lambda= 440-490nm).
(2) The electrical potential difference shown in the 4th table was impressed to the component obtained by the measurement above (1) of the brightness of a component, and a chromaticity, and it asked for the amount of currents, brightness, and a chromaticity. The result is shown in the 4th table.
[0087]
[A table 5]

第 4 表

	電 圧 (V)	電流量 (mA/cm²)	輝 度 (cd/m²)	色 度
実施例 1	8	5. 1 4	2 1 5	(0. 159, 0. 192)
実施例 2	8	3. 0	1 9 4	(0. 180, 0. 275)
実施例 3	8	3. 3 8	1 0 2	(0. 173, 0. 181)
比較例 1	6	6. 9	1 1 9	(0. 157, 0. 242)
比較例 2	8	2. 5 8	1 6 0	(0. 179, 0. 326)
比較例 3	8	6. 6 7	2 5 3	(0. 181, 0. 215)

[0088] Compared with the thing of the example of a comparison, as for the thing of an example, the y-coordinate (chromaticity) is small so that an example 1, the example 1 of a comparison and an example 2, corresponding example 2 of a comparison and example 3, and the corresponding example 3 of a comparison may be compared and may be known. Since the optical thickness specified in the example is main blue wavelength (lambda), this satisfies the formula of 4 pi/lambda [(nd)1+(nd)2] =2mpi (m= 2), and shows that blue purity is high.
(3) EL spectrum of the component obtained in EL spectrum example 1 and the example 1 of a comparison of a component was measured. The result is shown in drawing 2 . In the example 1, it turns out that a 460nm peak is reinforced and it is large clearly from drawing 2 . Thereby, it was shown by the configuration of the component of this invention that blue purity is high.
[0089] The EL element as the thickness of each class shows in the 5th table was produced like the production example 1 of an examples 4-6 (1) EL element. However, in the example 4, ITO of the high refractive index 1.92 was used instead of ITO used in the example 1. Moreover, TiO2 of the refractive index 2.4 which is a high refractility substrate layer between a substrate and the ITO film in the example 5 The layer was prepared by 48nm of thickness with the vacuum deposition method. Furthermore, MgF2 of the refractive index 1.38 which is a low refractility substrate layer between a substrate and the ITO film in the example 6 The layer was prepared by 80nm of thickness with the vacuum deposition method. The thickness of each class is shown in the 5th table, and optical thickness, and lambda and m are shown in the 6th table.
[0090]
[A table 6]

第 5 表

	各 層 の 膜 厚 (nm)					
	a	b	c	d	TiO_2層	MgF_2層
実施例 4	1 1 6	8 0	4 0	2 0	−	−
実施例 5	6 0	8 0	4 0	2 0	4 8	−
実施例 6	1 2 0	8 0	4 0	2 0	−	8 0

[0091]
[A table 7]

第 6 表－1

	光学膜厚			
	有機多層部 $(nd)_1$	透明電極 $(nd)_2$ 又は $(nd)_3$	TiO_2層 $(nd)_4$	$[(nd)_1+(nd)_2]$ 又は $[(nd)_1+(nd)_3]$
実施例4	80×1.7 +40×1.75 +20×1.7	116×1.92	－	4 6 3
実施例5	80×1.7 +40×1.75 +20×1.7	60×1.86	48× 2.4	3 5 1
実施例6	80×1.7 +40×1.75 +20×1.7	120×1.86	－	4 6 3

[0092]
[A table 8]

第 6 表－2

	λ (nm)	m
実施例4	4 6 3	2
実施例5	4 7 0	2
実施例6	4 6 3	2

[0093] In the example 5, since the echo by the interface of a high refractility substrate layer and a transparent electrode arises, optical thickness is [(nd)1+(nd)3], and by the interface, since pi change of a phase is done, it serves as the case where 4 pi/lambda [(nd)1+(nd)3] =(2m−1) pi (m= 2) is satisfied. as mentioned above, 4 pi/lambda x[(nd)1+(nd)3+(nd)4] =2mpi (m= 2) — and — The example 5 is filling 4 pi/lambda x[(nd)1+(nd)3] =(2m−1) pi (m= 2) (here, it is lambda= 466nm). Therefore, it is shown by especially the example 5 that blue purity is increasing.
(2) The electrical potential difference shown in the 7th table was impressed to the component obtained by the measurement above (1) of the brightness of a component, and a chromaticity, and it asked for the amount of currents, brightness, and a chromaticity. The result is shown in the 7th table.
[0094]
[A table 9]

第 7 表

	電圧 (V)	電流量 (mA/cm^2)	輝度 (cd/m^2)	色度
実施例4	8	5	2 0 0	(0.159, 0.170)
実施例5	8	4.5	1 7 0	(0.151, 0.134)
実施例6	8	4.6	2 1 0	(0.158, 0.175)

[0095] As for examples 4−6, compared with the example 1 of a comparison, blue purity is all high. In addition, EL efficiency of element of this invention is mostly changeless, or is superior to the result of examples 1−6 rather. This shows the predominance of a remarkable technique with the configuration using a light filter to effectiveness being set to 1 / 2 − 1/3 in order to raise color purity. Furthermore, the EL element of the configuration of this invention is very simple, and easy to produce.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the explanatory view showing various gestalten in case EL light generated in the organic multilayer section is emitted.
[Drawing 2] It is measurement drawing of EL spectrum of the component obtained in the example 1 and the example 1 of a comparison.

[Translation done.]

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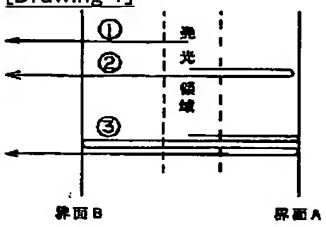
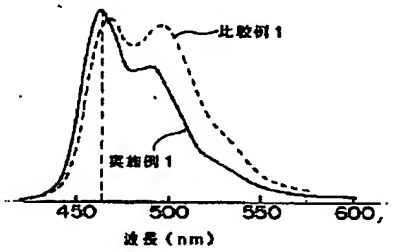
DRAWINGS

[Drawing 1]



[Drawing 2]



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